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ABSTRACT

Developed by a technical education specialist, this guide is designed to aid school administrators in planning and developing 2-year post-high school programs or evaluating existing programs in ornamental horticulture technology. In addition to general information on the program, contents include course outlines with examples of tests and references, technical education procedures, and laboratory layouts with equipment and costs and land requirements for five subject areas: (1) floriculture, (2) landscape development, (3) nursery operation, (4) turfgrass management, and (5) arboriculture. A selected list of scientific, trade, and technical societies concerned with the technology is appended. The suggested program may be modified to meet local, state and regional needs. (AW)

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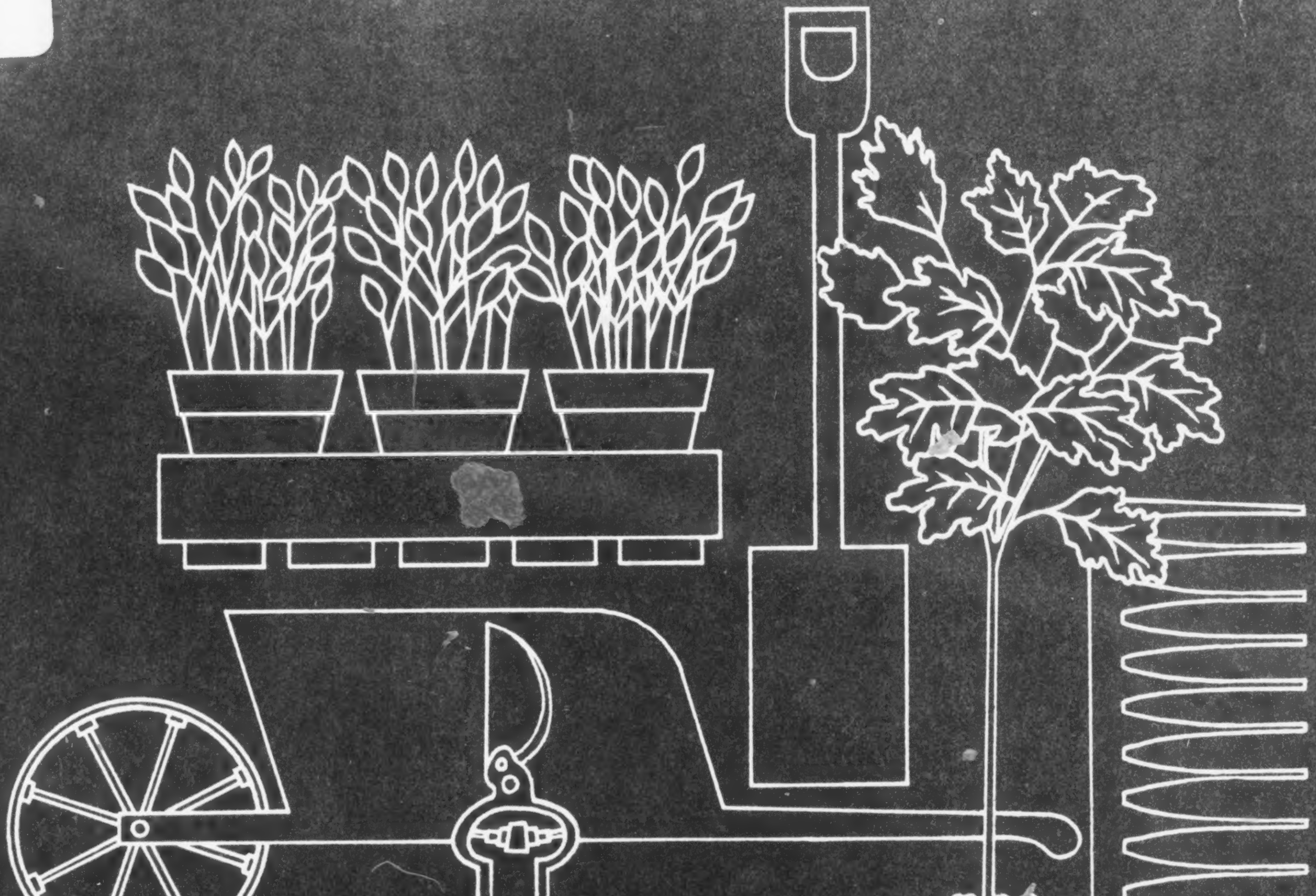
Ornamental Horticulture Technology

Suggested 2-Year Post High School Curriculums



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ORNAMENTAL HORTICULTURE TECHNOLOGY

Suggested 2-Year Post High School Curriculums

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Elliot L. Richardson, *Secretary*

OFFICE OF EDUCATION
Terrel H. Bell, *Acting Commissioner of Education*
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FOREWORD

ADVANCEMENTS in technology have caused great changes in horticulture as a business enterprise, as a service, and as an applied science. Some of the most significant changes have resulted from using new equipment, concepts, and methods to control plant growth and to improve the industry's products and services. These developments and the legislation of mid-1960's to promote the "beautification" of the Nation have directed attention toward personnel shortages, especially skilled technicians, in the horticultural industry.

This guide was prepared to aid the States in planning and developing 2-year post high school programs in ornamental horticulture technology, or in evaluating existing programs. Although the indicated level of instruction is post high school, the sequence of course work may well start at any grade level where students have the prerequisite background and understanding.

It includes suggested curriculums for five options: floriculture, landscape development, nursery operation, turfgrass management, and aboriculture. It also includes suggested course outlines with examples of texts and references; a sequence of technical education procedures; laboratory layouts with equipment and costs; a discussion of the library and its use, faculty and students services, and land requirements; and a selected list of scientific, trade, and technical societies concerned with the technology.

This guide was developed by Walter J. Brooking, technical education specialist in the Program Development Branch of the Division of Vocational and Technical Education, U.S. Office of Education. The basic materials were prepared by the State University of New York Agricultural and Technical College at Farmingdale, pursuant to a contract with the Office of Education.

Many useful suggestions were received from special consultants and advisers, owners of businesses, employees in the horticultural industry, and administrators and teachers in schools of technology. Although all suggestions could not be incorporated, each was considered carefully in the light of the publication's intended use. In view of this, it should not be inferred that the suggested curriculums are completely endorsed by any one institution, agency, or person. They are plans for a program; plans to be modified by administrators and their advisers to meet local, State, and regional needs.

ARTHUR LEE HARDWICK
Associate Commissioner for
Adult, Vocational, and
Technical Education

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CONTENTS

Page

FOREWORD iii

ACKNOWLEDGMENTS v

THE ORNAMENTAL HORTICULTURE PROGRAM 1

- Typical Employment Opportunities 3
- General Considerations 4
- Floriculture 7
- Landscape Development 7
- Nursery Operation 7
- Turfgrass Management 8
- Arboriculture 8
- Faculty 9
- Student Selection and Services 10
- Advisory Committees and Services 12
- Laboratory Equipment and Facilities 13
- Library 14
- Textbooks, References, and Visual Aids 15
- Scientific and Technical Societies 16

THE CURRICULUMS 17

- Floriculture Curriculum Outline 17
- Landscape Development Curriculum Outline 18
- Nursery Management Curriculum Outline 19
- Turfgrass Management Curriculum Outline 20
- Arboriculture Curriculum Outline 21
- Brief Description of Courses 22
- Curriculum Content and Relationships 25
- Suggested Continuing Study 28

COURSE OUTLINES 29

- Technical Specialty Courses 30
  - Drainage and Irrigation 30
  - Floral Design 34
  - Floriculture 36
  - Flower Shop Operation 38
  - Greenhouse Operations I 40
  - Greenhouse Operations II 42
  - Herbaceous Plants I 48
  - Herbaceous Plants II 51
  - Horticultural Applications 54
  - Horticultural and Turfgrass Equipment 59
  - House and Conservatory Plants I 63
  - House and Conservatory Plants II 66
  - Indoor Landscaping 70
  - Landscape Construction 73
  - Landscape Gardening 77
  - Landscape Plans I 79
  - Landscape Plans II 82
  - Municipal Arboriculture 85
  - Nursery Operation I 88
  - Nursery Operation II 90
  - Nursery Operation III 92
  - Plant Propagation 94

Page
Planting Plans I 96
Planting Plans II 99
Shade Tree Problems 104
Training Ornamental and Fruit Plants 107
Tree Pruning and Repair 109
Turfgrass Culture 112
Turfgrass for Golf Courses 118
Turfgrass Management I 121
Turfgrass Management II 126
Woody Plants I 131
Woody Plants II 134
Woody Plants III 136
Mathematics and Science Courses 138
Mathematics 138
Botany 140
Chemistry 148
Entomology and Plant Disease Control 151
Horticultural Science 153
Horticultural Soils 155
Plant Pathology 157
Auxiliary and Supporting Technical Courses 162
Arborist Business 162
Landscape Contracts and Specifications 164
Landscape Surveying 167
Salesmanship 170
Technical Reporting 172
General Courses 175
Business Organization and Management 175
Communication Skills 178
General and Industrial Economics 181
FACILITIES, EQUIPMENT, AND COSTS 184
General Planning of Facilities 184
Land Requirements 186
Laboratory Facilities and Equipment 186
Cost of Facilities and Equipment 191
Basic Curriculum Cost 192
Audio and Visual Aid Equipment 192
Horticultural Soils Course Equipment 192
Horticultural Applications Course Equipment 192
Woody and Herbaceous Plants Course Equipment 193
Floriculture Curriculum Equipment 193
Landscape Development Curriculum—
Landscape Plans Course 193
Landscape Construction Course Equipment 194
Landscape Surveying Course Equipment 194
Nursery Curriculum Equipment 195
Turfgrass Curriculum Equipment and Tools 196
Laboratory Equipment 196
Golf Course—9 Hole 196
Arboriculture Curriculum Equipment 196
Horticulture Complex With All Five Curriculums 198

Page

BIBLIOGRAPHY 199

APPENDIX

Selected List of Professional and Technical Societies and Organizations Concerned with Ornamental Horticulture and its Application. 203

THE ORNAMENTAL HORTICULTURE PROGRAM

ORNAMENTAL HORTICULTURE, or the cultivation and use of plants and flowers to control, beautify, and improve man's environment, is an old practice. It has become a multibillion dollar industry in this Nation which serves many and employs several thousand persons.

Recently there has been greater awareness and growing interest in substantially increasing the use of plants, flowers, turf, and shrubs for the beautification of municipal properties, urban areas generally, and the countryside. Growing emphasis on environmental improvement indicates this awareness and is only one of many factors which has created a shortage of the skilled personnel required to produce, plant, care for, and to distribute the materials used for horticultural purposes.

Modern technology has caused great changes in the propagation, culture, packaging, storing, care, and distribution of flowers, shrubs, turfgrass, and trees. New varieties of plants improve in beauty and adapability. New materials for containerized growth, storage, and distribution reduce cost and improve service to customers. Modern applications of the science of chemical plant growth control, such as fertilizers, growth stimulators, or depressants, defoliants and many others, are an important part of the horticultural producer's activities. Chemicals to kill or control weeds, molds, insects, plant parasites, and animals that feed on plants or affect their growth have been developed to a very sophisticated technological requirement for efficient and economical horticultural production. Special equipment and techniques are required for the use of these chemicals.

New machinery and sophisticated automatic watering, temperature and light controlling devices have been developed for the greenhouse and horticultural industry, and represent yet another facet of the technological impact on the industry.

All of these technical developments have brought about great changes in the horticultural field and cause a growing need for highly

Figure 1.—The systematic use of flowers, shrubs, trees, and grass to beautify and influence man's environment is an ancient art. Ornamental horticulture students learn that modern technology makes great changes in that art.

skilled technicians to cope with the increasingly complex scientific aspects of the industry. The following description of the major branches of ornamental horticulture will clarify the subject and provide a basis for the terms used throughout this publication.

Ornamental horticulture is the production of flowers and foliages of all kinds both indoors and out; and the consequent grading, arrangement, distribution, and marketing have become a sizable industry known as *floriculture.* Cut flowers are used by more and more people. Potted flowers and foliage are appreciated and used widely.

Shade, specimen, and ornamental trees are increasingly valued and guarded by the public. Removal of shade trees arouses the concern of residents, even if some of the trees have grown old and dangerous. This branch of the service, *arboriculture,* has come to mean not only the cultivation of trees and shrubs in a broad sense; but planting, transplanting, fertilization, insect and disease control, pruning, bracing, cabling, cavity work, and general care. Arboriculture has developed into a highly specialized field of importance and is, like floriculture, a part of ornamental horticulture.

It has been estimated that *turf* (with all phases of its production and management) may become the most valuable crop produced in the Eastern United States. A good lawn is becoming necessary to homeowners, and much money is spent establishing and maintaining good home lawns. Lawn seed production is a large and specialized business which requires special technical knowledge, skills, and aptitudes. Grass cover by sodding is a common practice. The turf is grown and the entire mat of plants and roots (sod) are transplanted quickly to areas requiring a lawn. Sod production for these turf areas requires much knowledge and ability and is an important and growing part of ornamental horticulture known as *turfgrass management.*

The production of hardy ornamental plants for the landscape is an important part of ornamental horticulture known as *nursery operation.* The successful nurseryman must be able to propagate and grow profitably the many different species and varieties required or desirable for planting in the home or public landscape.

Figure 2.—Since floriculture is a large business in the horticultural industry, horticultural students learn how to manage and operate such an enterprise. In addition, they study the scientific culture of flowers in greenhouses and outdoors just as these students are doing.

The garden center or roadside market where plants are held temporarily for sale to wholesale or retail customers is another type of nursery activity.

Construction of private and public buildings, parks and parkways has increased the need for the services of the expert in *landscape development*. A trained landscape man is prepared to build and maintain lawns, plant and cultivate trees, shrubs, flowers, and other plants; and to plan and construct landscape features including walks, paths, small pools, and walls. In addition, pruning, spraying, feeding of plants, and general outdoor maintenance work related to this area require the services of a competent landscape man. Ofter this work is done on a contractual basis.

Employment opportunities for qualified ornamental horticulture technicians are plentiful, but many of the jobs go unfilled each year. The young person who prepares for a career in this field has almost unlimited opportunities. Great shortages exist for golf course superintendents, grounds superintendents for schools, colleges, parks, industrial plants, cemeteries, municipalities, construction contractors, highway departments, and many others. A partial list of the positions filled by experienced and competent technicians in the ornamental horticulture field follows.

Typical Employment Opportunities

Arboretum Superintendent
Arborist
Bedding Plant Grower
Cemetery Superintendent
Commercial Sod Grower
Custom Spray Operator
Floral Designer
Flower Shop Manager

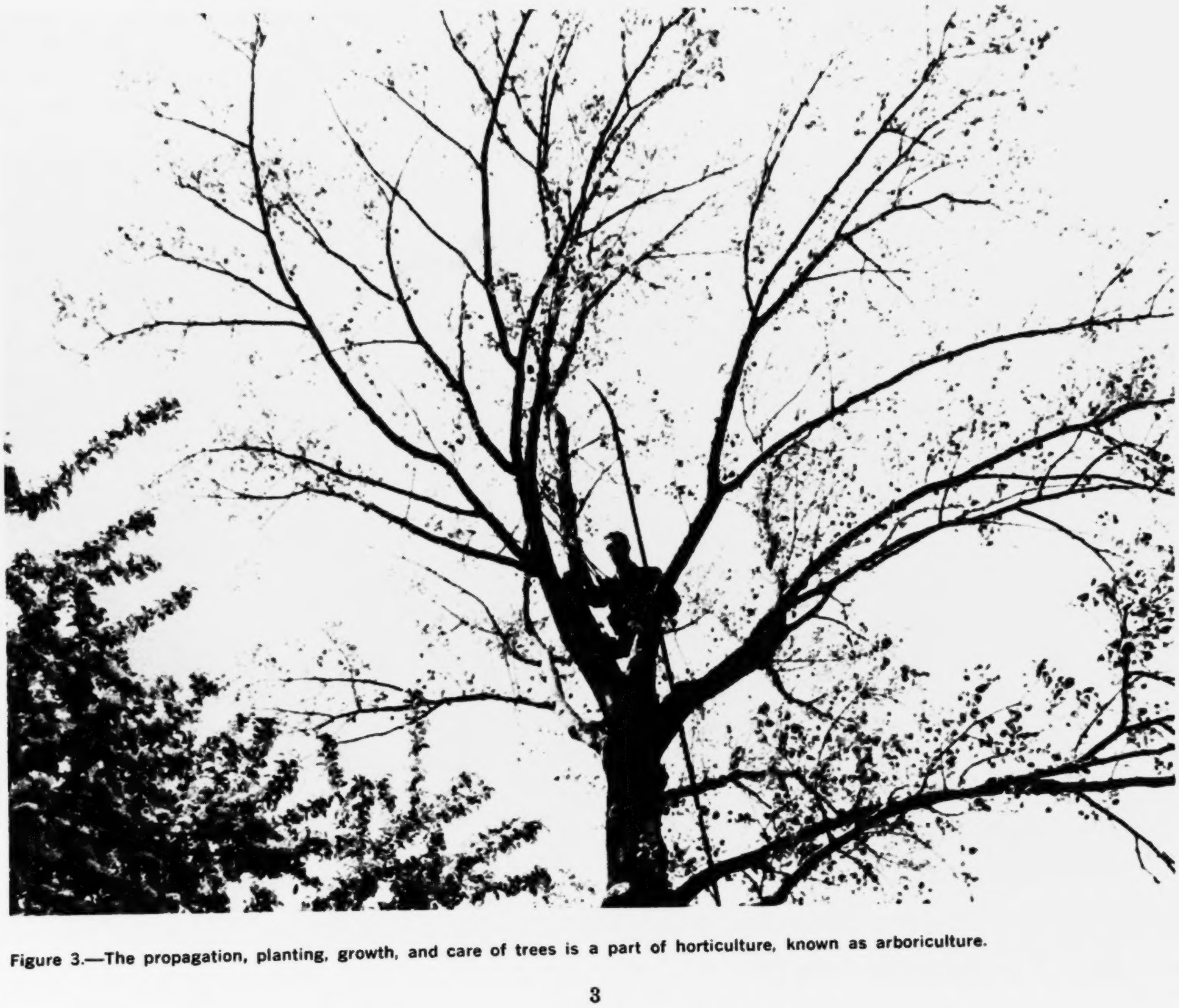

Figure 3.—The propagation, planting, growth, and care of trees is a part of horticulture, known as arboriculture.

Foliage Plant Specialist
Foreman, Landscape Company
Garden Center Manager
Golf Course Construction Contractor
Golf Course Construction Foreman
Greenhouse Manager
Greenhouse Manager for Public and/or Private Gardens
Greenhouse Technician for Research or Teaching Programs
Greenskeeper
Grounds Superintendent
Grounds Supervisor
Herbaceous Plant Specialist
Horticulturist
Indoor Plant Designer
Indoor Plant Installer
Irrigation Equipment Installer
Irrigation Equipment Salesman
Landscape Construction Foreman
Landscape Consultant
Landscape Contractor
Landscape Designer
Landscape Inspector
Landscape Maintenance Business
Landscape Nurseryman
Landscape Planting Foreman
Nursery Superintendent
Nursery Supervisor
Park Superintendent
Parkway Foreman
Parkway Supervisor
Plant Propagator
Pot Plant Grower
Private Estate Gardener
Retail Florist
Retail Nurseryman
Salesman for Horticultural Equipment
Salesman for Horticultural Supplies
Salesman for Landscape Services
Salesman for Plants
Superintendent, Golf Course
Turf Consultant
Turf Maintenance Business
Turf Research Technician
Turf Salesman
Turf Supply Salesman
Wholesale Florist
Wholesale Nurseryman
Woody Plant Specialist

General Considerations

This suggested program guide is designed to provide an intensive 2-year full-time program of study beyond high school for students of ornamental horticulture. The course work is designed to provide depth of understanding and

Figure 4.—Turfgrass culture for golf courses, lawns, grounds, parks, and highways is another specialized part of ornamental horticulture. It is a growing and increasingly technical speciality which offers good employment opportunities for students such as these.

some skill proficiency in the technical requirements for occupations in the broad field of ornamental horticulture in the United States.

The program is planned to prepare a competent technician in one of the five branches of ornamental horticulture (floriculture, arboriculture, turfgrass management, nursery operation or landscape development) in a program requiring 2 academic years and the summer between the first and second years.

It is an intensive, college level program and because of the limitation of time and the breadth of the field instruction must be highly efficient. Teaching methods must be streamlined in order to convey maximum information to students in a minimum amount of time and to improve their skills and competencies. Laboratory courses must be well-planned, implemented, and coordinated with classroom work so that each laboratory experience yields maximum understanding and improves the skills of the student. Courses in the curriculum can no longer be taught as isolated units but must be carefully integrated into a smoothly progressing program, organized and taught by a closely knit staff to insure proper timing of specific subject coverage.

The objective of the program recommended in this guide is to produce a competent ornamental horticultural technician in one of the five optional fields. The technician must be capable of working and communicating directly with engineers, scientists, managers, and production personnel in his specialized work; of satisfactorily performing work for his employer and of growing into positions of increasing responsibility. The graduate technician also should be an active, well-informed member of society.

A curriculum which, when mastered, will produce the type of graduate described earlier must be carefully designed. Each course must be planned to develop the student's knowledge and skills in that particular area and must be directly integrated into the curriculum. Each course contributes uniquely to the sequence of courses specially planned to produce a competent technician.

Because technicians are employed in varied, numerous, and often specialized situations, the adequately trained ornamental horticulture technician must have attained certain abilities, scientific knowledge, and technical skills. These have been broadly defined as follows:[1]

1. Proficiency in the application of scientific principles in the general areas of biology and chemistry that are pertinent to the individual's technical field in ornamental horticulture.
2. Facility with mathematics; ability to use algebra and trigonometry as tools as required by the technology in performing the many applications to ornamental horticulture; and some understanding of, though probably not facility with, higher mathematics.
3. An understanding of the materials, principles, techniques, and processes commonly used in ornamental horticulture technology.
4. An extensive knowledge of the field of specialization with competency in applying the knowledge in various activities. The degree of competency and the depth of understanding should be sufficient to establish rapport with all people in the field of ornamental horticulture and enable the graduate to perform a variety of detailed technical work. This requires individual judgment, initiative, and resourcefulness.
5. Communication skills that include the ability to interpret, analyze, and transmit facts and ideas graphically, orally, and in writing.

The ornamental horticulture technician will use the foregoing abilities, knowledge, and skills as he performs several (but usually not all) of the following general activities:[2]

1. Applies knowledge of science, mathematics, and horticulture in rendering direct technical assistance to biological scientists, landscape architects, business enterprises, plant propagators, horticulturists, plant breeders, highway departments, housing authorities, public agencies, municipalities, and other governmental units.
2. Designs, develops, or plans modification of existing gardens, grounds, estates, golf courses, nurseries, floral arrangements, parks, exhibit areas, and other horticultural features.
3. Plans, supervises, or assists in installation of complex horticultural projects such as pools, walls, walks, irrigation systems, patios, outdoor

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[1] U.S. Department of Health, Education, and Welfare, Office of Education. *Occupational Criteria and Preparatory Curriculum Patterns in Technical Education Programs.* OE-80015. Washington: U.S. Government Printing Office, Superintendent of Documents, 1962, p. 5.

[2] *Ibid.*

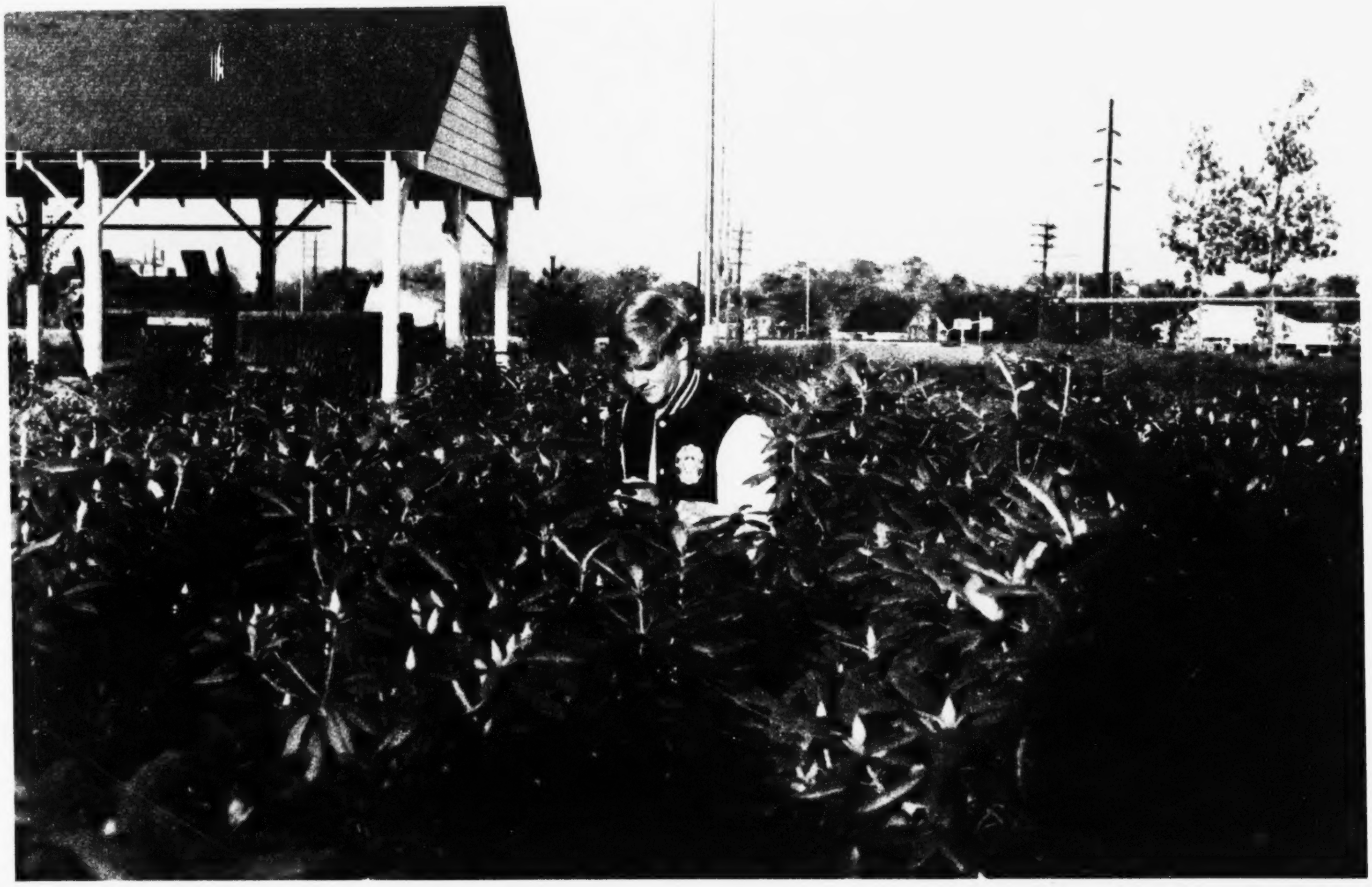

Figure 5.—Shrubs, bushes, and perennial horticultural materials, such as the rhododendron shown here, are the nurseryman's business. A nursery operation program at the post high school technical level requires sufficient land and facilities to propagate perennials each year, and to grow some of them through the fourth or fifth year at least.

living rooms, roads, bridle paths, play areas, and other such features.

4. Advises and recommends regarding the operation, repair, and maintenance of horticultural enterprises such as public parks, memorial parks, arboretums, playgrounds, golf courses, highways, cemeteries, home grounds, public grounds, estates, and educational institutions.

5. Plans production or operations as a member of the management unit responsible for efficient use of manpower, materials, money, and equipment in mass production of horticultural crops such as trees, shrubs, flowers, and turf.

6. Advises, plans, and estimates costs as a field representative of a manufacturer or distributor of technical horticultural equipment, services, or products.

7. Accepts responsibility for performance tests of plants and equipment used in ornamental horticulture and prepares appropriate technical reports for his superiors.

8. Prepares or interprets drawings and sketches and writes detailed specifications or procedures for work related to ornamental horticulture.

9. Selects, compiles, and uses technical information from references, standards, handbooks, biological and horticultural procedural outlines, technical digests, and research findings.

10. Analyzes and interprets information from trials, tests, research, and experiences of others and makes evaluations upon which technical decisions can be made.

11. Analyzes and interprets technical horticultural problems that involve independent decisions. Judgment requires substantive experience in the horticultural field in addition to scientific principles and technical know-how.

12. Deals with a variety of technical problems involving many factors and variables which require an understanding of several technical fields. This versatility is a characteristic that relates to breadth of applied scientific, technical, and horticultural understanding.

Some of the preceding 12 activities are broadly inclusive while others describe func-

Figure 6.—Floriculture, turfgrass culture, and nursery operation programs all need cold-frame and greenhouse propagation facilities. The facilities shown here are only a part of those available to students in the post high school program of ornamental horticulture at the State University of New York Agricultural and Technical College at Farmingdale, Long Island, N. Y.

tions which are quite specific. They neither exclude nor include functions or activities that might be considered the special prerogatives of recognized professional or skilled worker groups. The horticultural technician must be familiar with the work of the professional as well as the skilled craftsman. Few if any technicians perform all 12 but the work of all horticultural technicians requires some combination of them.

The materials in this guide have been organized to provide five optional curriculums to allow for adaptations so that other options such as horticultural merchandising and golf course management can be developed. Unless the total program in an institution is very large the options should be selected and provided by the administration of the school to best meet the needs of the community which it serves. It is not recommended to attempt to provide all five curriculums where some might be chosen by only a few students and result in classes being too small to be economically supportable.

Floriculture

The *floriculture* curriculum involves the business of growing and selling flowers, foliage, and related materials. It is directed toward employment with florists, in planning, growing, designing, managing, and selling floral products and services. The purpose is not to prepare for single or limited skills but for multiple responsibility occupations which require an understanding of flower culture and merchandising.

Landscape Development

The *landscape* curriculum focuses on preparing the student for employment in the broad field of landscape planning and construction. Despite the many good publications available on the subject, homeowners seek the advice of trained horticulturists when contemplating a complete or partial landscaping project. A trained landscape man is prepared to build and maintain lawns, plant and cultivate trees, shrubs, flowers, and other plants; and plan and construct landscape features including walks, paths, small pools, and walls. In addition, pruning, spraying, feeding, and other kinds of tree work require the services of competent landscape men.

Nursery Operation

The *nursery* curriculum deals with the production, harvesting, and sale of ornamental trees and shrubs. A person entering the field of ornamental horticulture, besides having a love of plants, must be able to propagate, grow to commercial size, harvest, and profitably sell many different species and varieties of woody plants. He must not only learn the names of many species and varieties but must also be able to identify them.

Besides the production or wholesale nursery there are nurseries specializing in the various phases of the retail business such as mail order merchandising, retail sales yards and garden centers. A garden center is a retail business specializing in the sale of plants and lawn and garden materials such as fertilizer, pesticides, lawnmowers, lawn and deck furniture, and other products related to garden living. Landscape nursery or landscape contracting is covered under the landscape option above.

Turfgrass Management

The *turfgrass management* curriculum prepares students for such positions as golf course construction and maintenance foreman, golf course superintendent, cemetery, park, and grounds supervisors. Instruction in addition to the basic horticultural courses include courses in turf maintenance as a business, turfgrass problems, horticultural and turf equipment, landscape plans, landscape construction, and topographical mapping.

Arboriculture

The *arboriculture* curriculum prepares students for such positions as foremen and salesmen for arboriculture firms; foremen and superintendents of estates, parks, State highways, college campuses, and other public grounds; manager or owner of a service organization for the practice of arboriculture. Instruction includes, in addition to the basic horticultural courses, study and practice in propagation, planting, transplanting, pruning, cabling, bracing, fertilization, and protection of trees from insects and diseases.

A 2-year ornamental horticulture curriculum

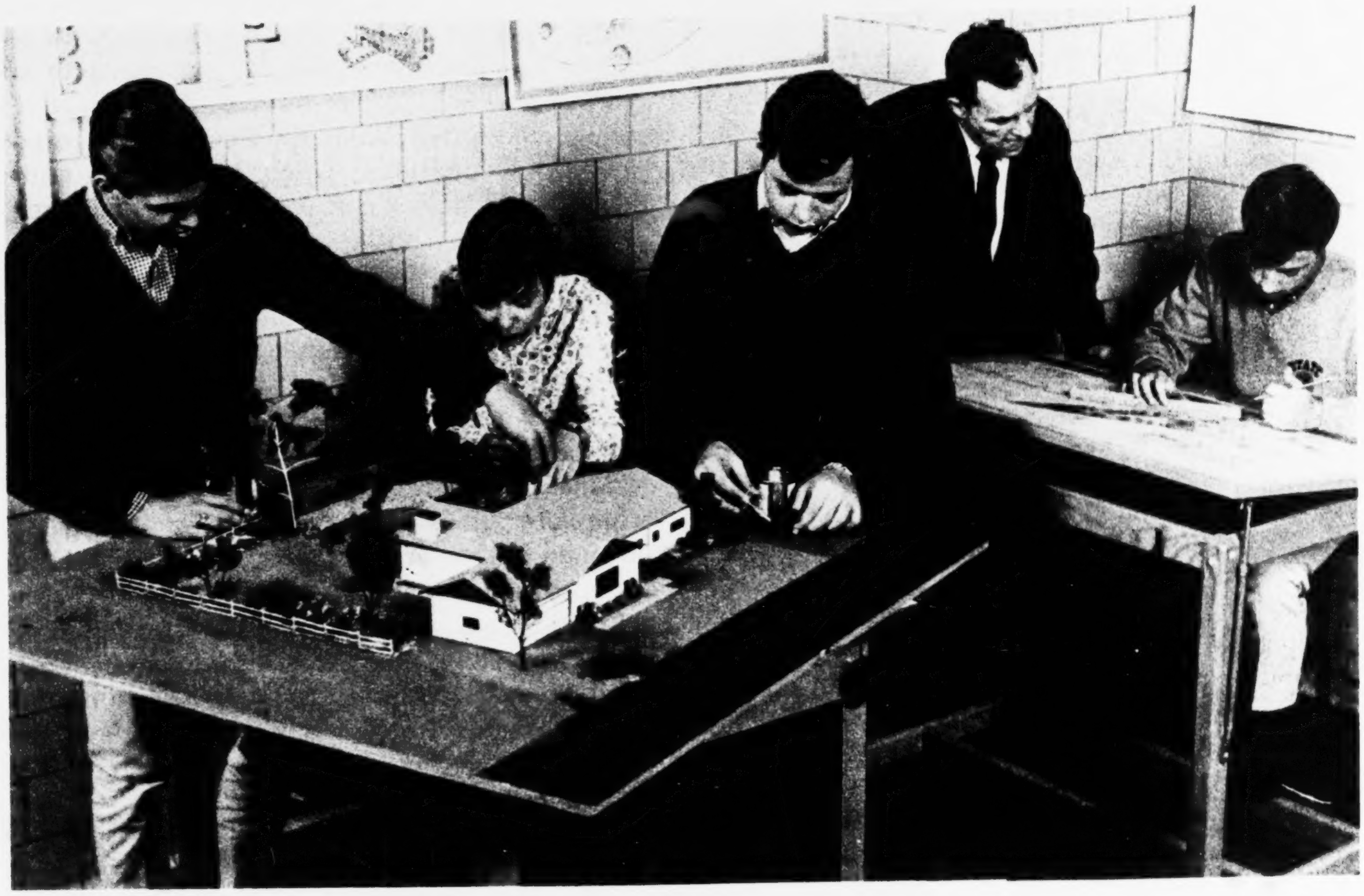

Figure 7.—Landscape development is being studied by these ornamental horticulture students. In this speciality, students learn to develop models and plans for use of horticultural materials, and to place and care for them through the initial planting stage.

must concentrate on primary needs if it is to prepare individuals for responsible technical positions. It must be essentially pragmatic in its approach and must involve a high order of specialization.

The curriculums suggested in this guide have been designed to provide maximum technical instruction in the time that is scheduled. To those who are not familiar with this type of educational service (or with the goals and interests of students who elect it) the technical program often appears to be inordinately rigid and restrictive. While modifications of this program may be necessary to meet specific local needs, it is recommended that the basic structure, content, and level of the curriculum be maintained in planning new programs or modifying existing ones.

A curriculum in technical education usually has five subject matter divisions, namely: (1) specialized technical courses in the technology (2) auxiliary or supporting technical courses (3) mathematics courses (4) science courses, and (5) general education courses. The technical subjects provide application of scientific principles. For this reason, mathematics and science courses must be coordinated carefully with technical courses at all stages of the program. This coordination is accomplished by scheduling mathematics, science, and technical courses concurrently during the first two terms. This curriculum principle will be illustrated at several points. It has been found that students who enter a technical program do so because of the depth in the field of specialization that the program provides. Many students who elect this type of educational program will bring to it a good background of general study.

Faculty

The effectiveness of an ornamental horticulture curriculum depends largely upon the competence and enthusiasm of the teaching staff. The specialized nature of the curriculum requires that the teachers, in addition to being good instructors, have special competencies based on proficiency in technical subject matter. It is important also that all members of the faculty and administration understand the educational philosophy, goals, and unique requirements that characterize this kind of education.

To be most effective, members of the faculty responsible for this program must have interests and capabilities which transcend their area of specialization. All of the faculty members should be well oriented in the requirements for study in ornamental horticulture and its applications so that they may use horticultural examples and subject matter as supporting material when they teach their respective courses. For example, if the communications courses are to be of maximum value, the communications teacher should be familiar with the communications problems and demands placed on ornamental horticulture personnel. Without such a background the communications course work may not offer the support that is needed in the total program of education for the ornamental horticulture technician.

A minimum of three, and usually four, full-time equivalent faculty members are required to teach the technical specialty courses in any ornamental horticulture technology curriculum option. Bear in mind, however, that entering classes of 20 to 30 students can be taught in lectures but may require two or three sections of 10 for laboratory work. One instructor usually is recognized as the head of the program. He must be technically competent in all phases of the technology and be able to provide the leadership and coordination needed for excellence in the program. Other instructors should preferably be full-time faculty members. The department head and at least one instructor must be employed during the first year of operation of the program, and all four (and perhaps more) will be needed during the second and subsequent years.

In addition to the staff which teaches the technical specialty courses it is obvious that provision must be made for faculty to teach the communication skills, technical reporting, mathematics, basic science, and general courses in the curriculum. Sufficient staff to teach these courses to the agricultural equipment technicians may already be in the institution but care must be taken to provide sufficient teaching capacity in these subjects without overloading the staff.

Obtaining competent ornamental horticulture instructors may be difficult because very few institutions have programs to prepare teachers of ornamental horticulture. The demand is growing faster than the supply.

The land-grant colleges, especially those which have accepted graduates of 2-year ornamental horticulture programs may be a source of teachers. Another source of faculty is to provide inservice training for interested and partially qualified teachers. Some vocational agriculture teachers have become very successful ornamental horticulture instructors and others are being prepared by inservice training. Teachers with farm backgrounds bring some helpful preparatory knowledge to an inservice training program. There is so much to ornamental horticulture that a good teacher is not easily prepared on the job unless he has a strong educational background in botany or agriculture and the motivation to qualify as an ornamental horticulture teacher.

A few graduates of 2-year agricultural and technical college technician programs are becoming good teachers of ornamental horticulture, especially after they have had occupational experience in the field; and have continued their formal study by increasing the depth of their scientific and technical subjects, and obtaining professional status in pedagogical preparation.

Persons who have been in business in some phase of ornamental horticulture or have worked in the field bring practical experience as potential teachers but often they need instruction and practice to meet the rigors of teaching or dealing with young people. If the department of ornamental horticulture is large enough, a person with this background can be used as a technical assistant with the help of the other teachers and a helpful and understanding administration which provides an inservice training program.

When teaching loads for ornamental horticulture courses are determined, consideration should be given to the number of contact hours. These teachers must devote a large amount of time to preparation for laboratory sessions—the development of special instructional aids, assisting students with individual projects, and reviewing reports—in addition to the usual teaching responsibilities. An effective teaching load should usually be 15 and not more than 20 contact hours per week. The use of a trained but nonteaching laboratory assistant to prepare set-up and teaching materials, and to perform other routine tasks for the teachers, may increase the total effectiveness of the teaching staff.

Class size in general should be limited to approximately 20, or multiples of 10. This limitation will make it possible to have two laboratory sections of 10 members each for each class group. Assigning more than 10 to the laboratory will limit the learning situation and should be avoided.

Student Selection and Services

The importance of properly enrolling qualified and adequately prepared students in sufficient numbers to fill each beginning class in any technician educating program cannot be overemphasized. If too few students are enrolled the whole program will be uneconomical, and often will lead to poor morale of both the students and the instructional staff.

Enrollment of a majority of a beginning class of students who are not qualified to start in a technician program will require the teaching staff to lower the level of their course material and thus to graduate students who lack the needed preparation for attractive employment. This practice disillusions both the graduates and employers, and if continued year after year it will cause the program to fail. To enroll classes of unprepared students also wastes the best capabilities of the faculty and leads to low morale through lack of challenge and opportunity to utilize their teaching abilities.

If a few unprepared students are permitted to enroll in a class where the majority are equally prepared, they almost certainly will fail because the rigor and intensity of the program at its proper level does not leave sufficient time for unprepared students to make up deficiencies and master the curriculum at the same time.

This curriculum is designed for high school graduates who have particular abilities and interests in ornamental horticulture. Students entering the program should have completed 1 year of algebra, 1 year of geometry, 1 year of biology, and 1 year of chemistry, or their equivalent.

There are many attractive opportunities for women in the field of ornamental horticulture. Women have interests and abilities which lend themselves to many phases of plant care, culture, floral design, and merchandising. These capabilities should be encouraged so that

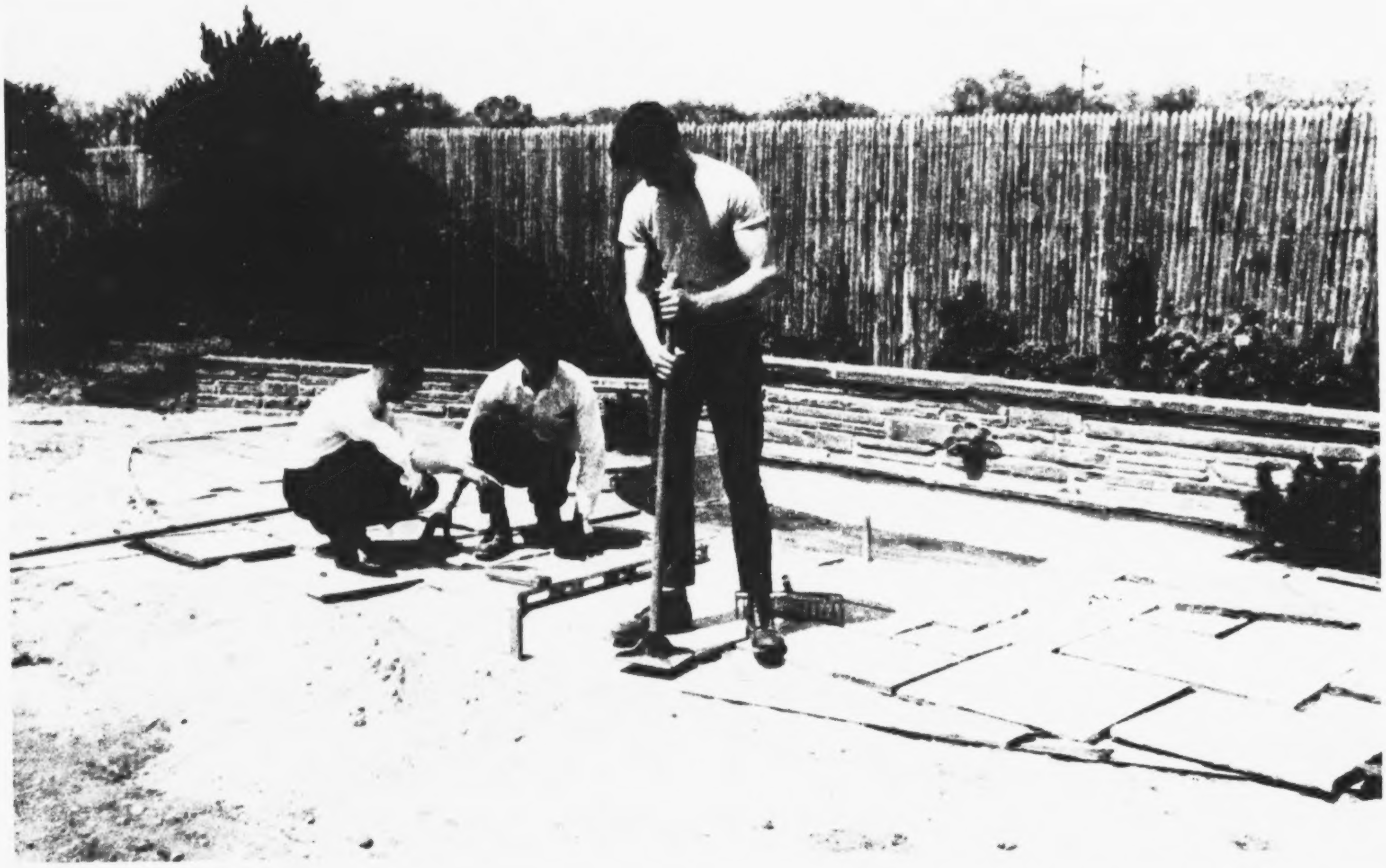

Figure 8.—Landscape development technicians must have work experience in constructing ornamental horticultural plans, using stone, wood, concrete, and other landscape construction materials.

women with an interest in horticultural work can become technicians in these highly specialized fields of applied science.

Student selection should be made on the basis of the individual's high school scholastic record, an interview in which the student expresses a motivating interest in succeeding in the program, and evidence of physical capability to perform all required work and activities. Many institutions use tests to help in student selection. Selection should be based on all available information regarding the student, and final acceptance should be governed by the judgment of the school that the student probably can succeed in the program.

Students who enter technical programs should have relatively similar capabilities and should exhibit some evidence of maturity and seriousness of purpose; otherwise the program may not be able to achieve its objectives. Curiosity, the ability to reason, and strong motivation are characteristics of most student technicians. The amount of material to be studied and the principles to be mastered require students who are well prepared in formal course material and have the ambition, desire, and the will to master a difficult program and to develop their capabilities to the limit.

The ability levels of those who do and those who do not meet these requirements will vary greatly as will their motivation toward the program. Motivation alone is not enough to insure a student's success in a technical program. If applicants do not have the necessary communication (language) skills, mathematics, or science preparation they should be required to compensate for these deficiencies and meet the entry requirements before being enrolled in the program. In many cases this pretechnical preparatory study should be offered at the school where the applicant will enter the technical program.

Many institutions which offer programs for educating technicians provide *pretechnical*[3] programs up to a full year's duration to give promising but underprepared students the opportunity to enter a technical program of their choice with a good probability of successfully completing it. A pretechnical program helps to solve student recruitment problems, assures high-quality graduates by starting with adequately prepared students, and gives promising students an opportunity to educate themselves to meet the Nation's urgent needs for technicians.

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[3] U.S. Department of Health, Education, and Welfare, Office of Education. *Pretechnical Post High School Programs, A Suggested Guide.* OE-80049. Washington: U.S. Government Printing Office, Superintendent of Documents, 1967.

Effective guidance and counseling are essential. The student should be aided in selecting educational and occupational objectives consistent with his interests and aptitudes. Whenever possible, standardized and special tests should be used to assist in student selection, placement and guidance. A student should be advised to revise his educational objectives if it becomes apparent that he is more suited to another program, either because he lacks interest in ornamental horticulture or lacks the scholastic ability to progress satisfactorily in the curriculum.

It is suggested that to develop each student to his fullest, each incoming student should be assigned to a faculty member who will act as the student's advisor for the duration of his program. Each instructor should consider this a vital part of his job. It takes time, but yields rich rewards. The faculty member must of necessity go out of his way at times to be most effective in assisting his students. Should personalities not be compatible, reassignments should be made. Every student should have a teacher-counselor who exhibits a personal interest in his educational progress and problems.

Ornamental horticulture graduates must be able to produce. They must be given broad and intensive experience in their class and laboratory work. In addition to the classroom and laboratory learning and practice, some kind of actual experience on the job is vital. This may be provided by caring for the campus, gardens, nursery, greenhouses, and related facilities belonging to the school, or by obtaining employment in the industry. Under some systems, students get horticultural work for the summer between the first and second years and at peak seasonal periods. Thus floriculture students would work for a florist and nursery students in a nursery. It is important that students work in the broad field of ornamental horticulture, where they get on-the-job occupational experience that will enrich the second year of formal instruction. Employment experience assists the student to obtain employment after graduation. To employ student technicians is of great benefit to the employer because he can thus get seasonal employees and also get acquainted with students he might wish to employ permanently after they graduate.

Many graduates from high school vocational agriculture departments are good candidates for post high school ornamental horticulture study. They have had some education about how things grow and they may also have had some good occupational experience. In addition they may know how to do the work.

A department of ornamental horticulture will develop a good reputation if its graduates can readily produce on the job. Students may work in cooperative programs which permit them to work a spring quarter, or semester, or in the fall instead of a summer.

Advisory Committees and Services

The success of technician education programs depends, to a great extent, on the formal and informal support of advisory committees. When an institution decides to consider the advisability of initiating a particular technological program, the chief administrator or dean should appoint the advisory committee.

The special advisory committee for the ornamental horticulture program should be comprised of representatives of employers and public employment services, scientific or technical societies and associations in the field, and knowledgeable civic leaders who meet with and advise the specialists on the school's staff. Such members serve without pay as interested citizens. They enjoy no legal status but provide invaluable assistance. The committee normally consists of about 12 members (but may vary from 6 to 20), who generally serve for a 1- to 2-year period. The head of the institution or the department head of the technology usually is chairman. It should be remembered that such people are always busy; therefore, meetings should be called only when committee action can best handle a specific task or problem.

The committee assists in surveying and defining the need for the technicians; the knowledge and skills they will require; employment opportunities; available student population; curriculum, faculty, laboratory facilities, and equipment; cost and financing of the program. When the studies indicate that a program should be initiated, the committee's help in planning and implementing it is invaluable.

Frequently the committee gives substantial help to school administrators in obtaining local funds and securing State and Federal support for the program. When the graduates seek employment, the committee aids in placing them in jobs and in evaluating their performance. These evaluations often will result in minor modifications which more closely relate the program to employment requirements.

Figure 9.—Facilities for ornamental horticulture technology programs should be large enough to provide work experience for all students. They should be similar to those in the industry and have modern technological equipment such as the automatic flower watering devices shown above.

The advisory committee can use this guide, designed primarily for planning and developing full-time preparatory programs in post high school institutions, as a starting point—modifying it to meet local needs. The program can also form the basis for courses to meet the requirements of employed adults who wish to upgrade or update their skills and technical capabilities. In this way the school administration, with the help of the committee and special consultants, can effectively initiate the needed program, quickly develop it to a high level of excellence, and maintain its timeliness.

It is strongly recommended that an advisory committee be provided for ornamental horticulture. Members should be appointed for fixed terms, but at staggered intervals to maintain continuity. A fixed period of time makes it easy to replace a member if he becomes too busy or is otherwise unable to serve.

Laboratory Equipment and Facilities

Laboratories and equipment for teaching horticulture technology programs must meet high standards of quality since the objectives and the strength of the programs lie in providing valid laboratory experience, basic in nature, broad in variety, and intensive in practical experience. Well-equipped laboratories with sufficient facilities for all students to perform the laboratory work are required for these courses. The training program should include experiences which illustrate the function and application of a wide variety of plants, material, equipment, devices, units, and systems.

Variety and quality of equipment and facilities are more important than quantity. Laboratory equipment and facilities are a major element of the cost of such a program but they are indispensable if the training objectives are to be met.

Sufficient, good land acreage with water for irrigation is necessary. Fertile soil for annuals, gardens, nursery, trees, turf, and practice in landscape development must be available. Over a period of time valuable teaching materials can be developed in the form of gardens designed in the classroom and executed in the laboratory. An extensive nursery will be a natural result following propagation practice in the laboratory. If a campus is available, plant materials can be added for study. The campus might even be developed as an ornamental horticulture laboratory utilizing a variety of materials, even possibly including different examples of street trees and grasses.

Greenhouse and head house facilities are required for any program in ornamental horticulture and they must be available when the program begins.

Facilities and equipment are discussed in

Figure 10.—Students in ornamental horticulture programs can contribute significantly to the appearance of school grounds, but any gain in educational experience is incidental. Therefore, this kind of activity must not be considered a major part of the program.

detail in the section "Facilities, Equipment and Costs."

Library

Dynamic developments causing rapid changes in technological scientific applications and practice make it imperative that the student of any technology learn to use a library. Therefore, instruction for students in technologies should be library oriented so they learn the use of the library and form the habit of using it as a learning tool. This helps to develop the professional attitude in the student and further assists him to depend on libraries as a means of keeping abreast of the new developments in a rapidly changing technology. The growth and success of the graduate technician in his work will depend in large measure on his ability to keep abreast of changes in his field.

Instructors of all courses should constantly keep the student aware of the extent to which a library contains useful information which can be helpful and is a part of the study in his curriculum. Planned assignments of library projects calling for the student to go to the library and prepare reports on pertinent subjects in his courses enable him to understand the resources available in libraries and how they relate to his technology.[4]

The content of a library must adequately provide the literature containing the knowledge encompassed by all subjects in a curriculum and extending somewhat beyond the degree of complexity or depth encountered in classroom activities. Literature dealing with highly specialized aspects of a subject may be acquired as needed or may be borrowed by the librarian from more comprehensive libraries.

The teaching staff and the library staff should actively cooperate with one another. The teaching staff must cooperate with the library staff on materials to be acquired and should be responsible for the final selection of the materials

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[4] U.S. Department of Health, Education, and Welfare, Office of Education. *Criteria for Technician Education, A Suggested Guide.* OE-80056. Washington: U.S. Government Printing Office, Superintendent of Documents, 1968.

Figure 11.—Ornamental horticulture laboratories must include all the instruments and apparatus necessary for studying the scientific principles of the technology. These horticultural students are studying botany in a well-equipped laboratory.

that support their technical courses. They must take the initiative in recommending new library content to keep it current, pertinent, and useful. The library should contain, in addition to reference books on all important aspects of ornamental horticulture, current magazines pertaining to ornamental horticulture, bulletins, and information from the local extension service and a wealth of trade and commercial literature. The library staff should periodically supply the teaching staff with a list of recent acquisitions complete with call numbers. Technical and trade journals should either be circulated to the teaching staff or placed in a staff reserved area for a short time before they are made available for general library use.

Textbooks, References, and Visual Aids

Textbooks, references, and visual aids for teaching any technology must constantly be reviewed and supplemented in light of (1) the rapid developments of new knowledge in the field, and (2) the results of research in methods of teaching and developing basic concepts in the physical sciences and mathematics. This is especially true in ornamental horticulture. The development of whole new areas of theoretical and applied scientific knowledge demands new textbooks, new references, new material in scientific and technical journals, and new visual aid materials.

New textbooks will reflect new methods of teaching scientific principles and applications as fast as current educational research becomes applicable. It is, therefore, mandatory that instructors constantly review new texts, references, and visual aid materials as they become available and adopt them when they are an improvement over those suggested here or those being used.

The suggested texts and references have been carefully selected. From the lists presented it should be possible to select suitable texts. This does not mean that unlisted books are unsuitable. There are, no doubt, excellent ones which have not been included only because of lack of familiarity with them.

Before a department head or instructor undertakes a program in ornamental horticulture technology, or any course contained in the curriculum, he should familiarize himself with the texts and references listed here and any new ones available. He will then be able to select the text which best serves his particular needs.

Visual aids can be of great help in many teaching programs. The suggested aids have been selected from an extensive list and represent those considered most suitable at the time the curriculum was prepared. Again, many have been omitted because the variety and extent of the materials make an all-inclusive listing prohibitive. From those listed and others available and pertinent, an instructor may select the visual aids which meet his teaching objectives.

Scientific and Technical Societies

Scientific and technical societies[5] and trade associations are an important source of instructional materials and other benefits for teachers and students. Such societies provide, through their publications and meetings, reports and continuing discussion of new concepts, processes, techniques, and equipment in the physical sciences and related technologies. Their presentation and interpretation of scientific and technical discoveries explain the relationship of the theoretical scientist's work to the applied science practitioner's requirements. They are invaluable aids in keeping abreast of new developments in a particular phase of science.

Less conspicuous, but extremely important, is the support which societies may give (1) in helping to develop evidence of need for a training program, (2) in helping to promote the program, (3) in enlisting members' support for the program, (4) in helping to provide work experience for students, and (5) in helping with the placement of graduates.

Associations and societies may supply resource people to speak to classes. They also may serve as hosts on field trips when student groups explore specific phases of the industry.

Instructors should be encouraged to become active members in these societies so that they may learn quickly of new technological developments. Membership will also enable them to meet people in the community who are actively interested in the field. Some educational institutions pay all, or part, of the costs of membership dues and attendance at local or national meetings in order to encourage staff participation in selected societies.

Early in their studies students should be required to become acquainted with the literature and services of scientific, technical, and engineering societies. They should also be encouraged to join those which offer student-affiliate memberships.

The following is a selected list of societies and associations which relate to ornamental horticulture:*

American Association of Botanical Gardens and Arboretums
American Forestry Association
American Institute of Park Executives, Inc.
American Rose Society
American Society for Horticultural Science
Associated Landscape Architects
Holly Society of America
International Shade Tree Conference
National Arborist Association
National Landscape Nurserymen's Assoc.
Society of American Florists
American Association of Nurserymen, Inc.
American Horticultural Society
American Rhododendron Society
American Seed Trade Association
American Society of Landscape Architects
Associated Landscape Contractors
International Plant Propagator's Society
Men's Garden Clubs of America
National Association of Gardeners
National Parks Association
Society of American Foresters
Women's National Farm and Garden Association

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*NOTE: See appendix for a brief description of each of these organizations as of 1967.

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[5] U.S. Department of Health, Education, and Welfare, Office of Education. *Scientific and Technical Societies Pertinent to the Education of Technicians.* OE-80037. Washington: U.S. Government Printing Office, Superintendent of Documents, 1965.

THE CURRICULUMS

Floriculture Curriculum Outline

	Hours Per Week			
First Semester	*Class*	*Laboratory*	*Outside Study*	*Total*
Chemistry	3	3	6	12
Communication Skills	3	0	6	9
Mathematics	3	0	6	9
Horticultural Soils	2	2	4	8
Horticultural Applications	1	3	2	6
Botany	3	3	6	12
Total	15	11	30	56
Second Semester				
Technical Reporting	2	2	4	8
Floriculture	1	6	2	9
Herbaceous Plants I	1	2	2	5
Woody Plants I	2	2	4	8
Horticultural Science	2	6	4	12
Entomology and Plant Disease Control	3	3	6	12
Total	11	21	22	54

Summer Session

Occupational experience and studies to meet special requirements of State or institution; approximately 12 weeks of full-time practice in *floriculture* on the job, or as provided by the college.

	Class	Laboratory	Outside Study	Total
Third Semester				
Floral Design	1	3	2	6
Greenhouse Operations I	2	6	4	12
Herbaceous Plants II	1	3	2	6
House & Conservatory Plants I	2	2	4	8
General and Industrial Economics	3	3	6	12
Total	12	17	24	53
Fourth Semester				
Flower Shop Operation	2	6	4	12
Greenhouse Operations II	2	6	4	12
House & Conservatory Plants II	1	2	2	5
Salesmanship	3	0	6	9
Indoor Landscaping	1	2	2	5
Business Organization & Management	3	0	6	9
Total	12	16	24	52

Landscape Development Curriculum Outline

	Hours Per Week			
First Semester	*Class*	*Laboratory*	*Outside Study*	*Total*
Chemistry	3	3	6	12
Communication Skills	3	0	6	9
Mathematics	3	0	6	9
Horticultural Soils	2	2	4	8
Horticultural Applications	1	3	2	6
Botany	3	3	6	12
Total	15	11	30	56

Second Semester				
Technical Reporting	2	2	4	8
Landscape Gardening	1	6	2	9
Herbaceous Plants I	1	2	2	5
Woody Plants I	2	2	4	8
Horticultural Science	2	6	4	12
Entomology and Plant Disease Control	3	3	6	12
Total	11	21	22	54

Summer Session

Occupational experience and studies to meet special requirements of State or institution; approximately 12 weeks of full-time practice in *landscape development,* on the job, or as provided by the college.

Third Semester				
Landscape Plans I	1	6	6	13
Landscape Contracts and Specifications	2	0	4	6
Turfgrass Culture	2	2	4	8
Herbaceous Plants II	1	3	2	6
Woody Plants II	2	2	4	8
General and Industrial Economics	3	0	6	9
Total	11	13	26	50

Fourth Semester				
Landscape Plans II	1	9	6	16
Landscape Construction	1	3	2	6
Landscape Surveying	1	4	2	7
Woody Plants III	2	2	4	8
Salesmanship	3	0	6	9
Business Organization & Management	3	0	6	9
Total	11	18	26	55

Nursery Management Curriculum Outline

	Hours Per Week			
First Semester	*Class*	*Laboratory*	*Outside Study*	*Total*
Chemistry	3	3	6	12
Communication Skills	3	0	6	9
Mathematics	3	0	6	9
Horticultural Soils	2	2	4	8
Horticultural Applications	1	3	2	6
Botany	3	3	6	12
Total	15	11	30	56
Second Semester				
Technical Reporting	2	2	4	8
Nursery Operation I	1	6	2	9
Herbaceous Plants I	1	2	2	5
Woody Plants I	2	2	4	8
Horticultural Science	2	6	4	12
Entomology and Plant Disease Control	3	3	6	12
Total	11	21	22	54

Summer Session

Occupational experience and studies to meet special requirements of State or institution; approximately 12 weeks of full-time practice in *nursery management*, on the job, or as provided by the college.

Third Semester				
Nursery Operation II	3	3	6	12
Planting Plans I	1	3	6	10
Plant Propagation	3	3	6	12
Woody Plants II	2	2	4	8
General and Industrial Economics	3	0	6	9
Total	12	11	28	51
Fourth Semester				
Nursery Operation III	2	3	4	9
Planting Plans II	1	6	4	11
Landscape Surveying	1	4	2	7
Woody Plants III	2	2	4	8
Salesmanship	3	0	6	9
Business Organization & Management	3	0	6	9
Total	12	15	28	53

Turfgrass Management Curriculum Outline

	Hours Per Week			
First Semester	*Class*	*Laboratory*	*Outside Study*	*Total*
Chemistry	3	3	6	12
Communication Skills	3	0	6	9
Mathematics	3	0	6	9
Horticultural Soils	2	2	4	8
Horticultural Applications	1	3	2	6
Botany	3	3	6	12
Total	15	11	30	56

Second Semester

Technical Reporting	2	2	4	8
Turfgrass Culture	2	2	4	8
Herbaceous Plants I	1	2	2	5
Woody Plants I	2	2	4	8
Turfgrass Management I	1	6	2	9
Entomology and Plant Disease Control	3	3	6	12
Total	11	17	22	50

Summer Session

Occupational experience and studies to meet special requirements of State or institution; approximately 12 weeks of full-time practice in *turf management*, on the job, or as provided by the college.

Third Semester

Tree Pruning and Repair	1	3	2	6
Landscape Plans I	1	6	6	13
Horticultural and Turfgrass Equipment	2	3	4	9
Landscape Contracts and Specifications	2	0	4	6
General and Industrial Economics	3	0	6	9
Turfgrass Management II	2	3	4	9
Total	11	15	26	52

Fourth Semester

Turfgrass for Golf Courses	2	3	4	9
Drainage and Irrigation	2	3	4	9
Landscape Construction	1	3	2	6
Salesmanship	3	0	6	9
Business Organization & Management	3	0	6	9
Landscape Surveying	1	4	2	7
Total	12	13	24	49

Arboriculture Curriculum Outline

		Hours Per Week		
First Semester	*Class*	*Laboratory*	*Outside Study*	*Total*
Chemistry	3	3	6	12
Communication Skills	3	0	6	9
Mathematics	3	0	6	9
Horticultural Soils	2	2	4	8
Horticultural Applications	1	3	2	6
Botany	3	3	6	12
Total	15	11	30	56
Second Semester				
Technical Reporting	2	2	4	8
Tree Pruning and Repair	1	3	2	6
Turfgrass Culture	2	2	4	8
Woody Plants I	2	2	4	8
Horticultural Science	2	6	4	12
Entomology and Plant Disease Control	3	3	6	12
Total	12	18	24	54

Summer Session
Occupational experience and studies to meet special requirements of State or institution; approximately 12 weeks of full-time practice in *arboriculture,* on the job, or as provided by the college.

	Class	*Laboratory*	*Outside Study*	*Total*
Third Semester				
Training Ornamental and Fruit Plants	2	3	4	9
Horticultural and Turfgrass Equipment	2	3	4	9
Landscape Contracts and Specifications	2	0	4	6
Plant Pathology	3	3	6	12
Woody Plants II	2	2	4	8
General and Industrial Economics	3	0	6	9
Total	14	11	28	53
Fourth Semester				
Municipal Arboriculture	2	4	4	10
Business Organization & Management	3	0	6	9
Shade Tree Problems	2	4	4	10
Arborist Business	1	3	2	6
Woody Plants III	2	2	4	8
Salesmanship	3	0	6	9
Total	13	13	26	52

Brief Descriptions of Courses

FIRST SEMESTER

Chemistry

The fundamental laws of chemistry, including atomic structure, chemical bonds, reactions, solutions, ionization, and *p*H.

Communication Skills

Designed to promote greater competence in reading, writing, talking, and listening. Use of communication skills in interpersonal relationships is emphasized.

Mathematics

A unified mathematics program offering the principles of algebra, trigonometry, set theory; the use of the slide rule; and an introduction to applied electronic data processing.

Horticultural Soils

The study of *soil* texture, structure, organic matter, and plant nutrients as they are related to the use of lime, fertilizers, manures, peats, and *soil* conditioners to raise horticultural *soils* to high levels of production.

Horticultural Applications

An orientation course to provide field experience in the various phases of horticulture. Tools, materials, procedures, techniques, and standards of workmanship are described and demonstrated, and then the students perform and practice.

Botany

To provide an elementary understanding of the fundamentals of plant anatomy, morphology, physiology, taxonomy, reproduction, genetics, and pathology.

SECOND SEMESTER

Technical Reporting

A study of effective ways of presenting technical information. The student learns how to use graphs, drawings, sketches, and outlines for various types of oral and written reports.

Floriculture

This course gives every student the opportunity to apply and explore plant culture under glass and outdoors. The course emphasizes laboratory experience and intensive instruction to provide knowledge, skills, and criteria for judgment in plant production.

Landscape Gardening

A course in landscape development and appreciation. Elementary drawing and the principles of art for creative design are taught, applying in lettering, freehand, and perspective drawing. Field practice in garden improvement and operation is included.

Nursery Operation I

An introduction to techniques and practices used in the commercial production of herbaceous perennials, ground covers, deciduous shrubs and trees, conifers, and broadleaf evergreens. Greenhouse and nursery procedures and practices are emphasized.

Turfgrass Culture

The course begins with the soil required for different kinds of turf and continues intensive study of successive steps from propagation through seed bearing; and includes methods of identification of turf species at all stages of development. Pest identification, prevention, and control are studied in detail.

Tree Pruning and Repair

A basic course for students majoring in arboriculture, including pruning and tree repair principles and techniques. Climbing and rope work are practiced as laboratory experience.

Herbaceous Plants I

Classification, identification, and general culture of perennials, bulbs, and roses commonly used in garden planting.

Woody Plants I

An introductory study of woody plants grown in nurseries for landscape purposes and, secondarily, of those found in arboretums, woodlands, and fields within the State and adjacent States. Emphasis is on deciduous shrubs and small trees, their identification, culture, uses, flowers and fruits, and ecological relationships.

Horticultural Science

Techniques and procedures are used to modify, complement, and supplement the total plant environment so the horticulturist may propagate, produce, and maintain plants and plantings. Laboratory exercises are designed to develop specific skills dealing with plant growing, transplanting, and pruning.

Turfgrass Management I

A course utilizing and extending the elementary information and techniques learned in Turfgrass Culture. Laboratory sessions should largely be practice in constructing and maintaining specialized turf areas.

Entomology and Plant Disease Control

A study of the nature, structure, growth, habits, and injurious effects of insects and related forms. The identification of common plant pests, diseases transmitted by insects and their injuries to plants. Insect and disease control measures and application equipment are also studied.

THIRD SEMESTER

Floral Design

Application of principles in the art of floral design as to form, styles, and composition. Students design floral arrangements, wreaths, sprays, baskets, bouquets, wedding flowers, and corsages in the laboratory.

Greenhouse Operations I

A study of locations and conditions most favorable for the production of cut flowers and pot plants. Wholesale and retail flower establishments are also studied.

Herbaceous Plants II

A continuation of Herbaceous Plants I, with emphasis on annual and biennial flowers, and fall flowering perennials. Landscape use of herbaceous plants is studied and design and growth of flower borders is practiced.

Woody Plants II

A continuation of Woody Plants I, covering additional deciduous shrubs and trees. Emphasis is placed on broadleaved and narrowleaved evergreens.

House and Conservatory Plants I

A course in identification, culture, and propagation of florist pot plants, conservatory plants and plants of economic importance. Includes principles and construction of terrariums and dish gardens.

General and Industrial Economics

A study of general economic principles, and an analysis of the factors involved in management of personal finances and methods of cost control in a business enterprise.

Plant Pathology

A study of plant pests and diseases, methods of control, and chemicals and equipment used.

Landscape Plans I

A study of the theory and principles of landscape design applied to selected landscape problems. In the laboratory preliminary sketches and final presentation drawings are made in plan, elevation, and perspective.

Landscape Contracts and Specifications

A study of landscape, nursery, and turf cost finding, contract and specification structure, and methods of estimating landscape and construction costs. Calculating areas and volumes and estimating plant quantities for horticultural projects is emphasized.

Nursery Operation II

A study of commercial stock production, emphasizing plant growth patterns and plant responses in relation to soils, water, fertility, planting techniques and spacing, top and root pruning.

Planting Plans I

A course in planting design of small home grounds. On-the-job sketching and plan presentations as done by nurseries are practiced.

Plant Propagation

Designed to teach the student to recognize and explore various techniques and facilities used in the propagation of plants grown by commercial nurserymen. Exacting techniques are examined and reproduction applied in the sexual and asexual of ornamental plants.

Horticultural and Turfgrass Equipment

A study of the operation and maintenance of motive power used in various horticultural enterprises.

Turfgrass Management II

A study of business procedures used by professional turfgrass growers, including cost accounting, time study, record keeping, and evaluation of equipment and materials.

Training Ornamental and Fruit Plants

A continuation of Tree Pruning and Repair, with emphasis on training and pruning ornamental and fruit plants, tree repair, and tree surgery.

FOURTH SEMESTER

Flower Shop Operation

A study of the importance of flower shop location and the management and operation of a shop. The art of making corsages, pieces for special occasions, and arranging flowers for the home, church, hotel, and public buildings is studied and practiced.

Greenhouse Operations II

A continuation of Greenhouse Operations I, emphasizing the study of florist crops, modern technical applications, and environmental elements to be controlled in producing cut flowers and pot plants under glass.

House and Conservatory Plants II

A continuation of House and Conservatory Plants I, with particular emphasis on the study of plants used for indoor decoration. Indoor lighting, its use and effects on plant growth also are studied.

Salesmanship

A study in creative selling and the development of the sales personality. The classification and use of buying motives, analysis of customer types, and organization of the sales effort are studied.

Indoor Landscaping

A study of the use of ornamental plant life in homes and public buildings. In the laboratory students draw plans for room interiors, showing plants and their value to the indoor decorating scheme.

Business Organization and Management

A study of the business universe. Ownership, risk, and risk bearing, finance and the financial system, marketing and transportation are studied.

Landscape Plans II

A continuation of Landscape Plans I, with progressively difficult problems. Emphasis is placed on basic details of landscape architectural construction. Grading, construction, planting, and staking plans are also studied and performed as a part of the laboratory work.

Landscape Construction

A study in the selection and use of construction materials for steps, walks, seats, walls, fences, and other landscape features.

Woody Plants III

An advanced study of the plants previously considered, especially of named varieties or cultivars, the lesser known trees, shrubs, vines, and ground covers. Designed to provide an understanding of plant peculiarities and requirements and to teach how to evaluate woody plants for landscape purposes.

Nursery Operation III

A continuation of the study of commercial plant production, dealing with programing plant production and nursery land use, as related to nursery layout in sections and blocks. Cost finding techniques, and establishing price and profits are studied and equated.

Planting Plans II

A continuation of Planting Plans I, with progressively difficult problems and added studies in sketching and perspective drawing.

Turfgrass for Golf Courses

A course in problems in the design and operation of golf courses and other large turf areas. Detailed analysis of problems and preparation of graphic solutions are required of all students. Field trips and study of data in technical journals are used to expand the scope of the course.

Drainage and Irrigation

A study of various types of drainage and irrigation systems, including materials and equipment, their cost, upkeep and design, and application of watering systems.

Landscape Surveying

An elementary study of and practice in the use of various surveying instruments necessary to measure land, plot topographical areas, and determine levels of elevation.

Municipal Arboriculture

A study of the organization and management of the work done by municipal departments concerned with the care of trees. Street tree planning, planting, selection, and care are emphasized.

Shade Tree Problems

A course in the diagnosis and treatment of tree ills; study of the principles and techniques used to protect trees from disease and damage, common insects, diseases, and standard control practices.

Arborist Business

A study of the commercial arboriculture business. The course includes: an analysis of factors essential to the operation of a successful tree-care business; study of organization, personnel management, business methods, ethics, promotional methods, cost estimating, and cost of operations; visits to local arborists' establishments; and meetings with successful arborists.

Curriculum Content and Relationships

Functional competence in a broad field such as ornamental horticulture has at least three components around which the curriculum must be designed:

1. The training should prepare the graduate to be a productive employee in an entry level job.

2. The broad technical training, together with a reasonable amount of experience, should enable the graduate to advance to positions of increasing responsibility.

3. The foundations provided by the training must be broad enough so that the graduate can do further study within his field (reading of journals and new texts, formal course work). The curriculums in this guide have been designed to meet these requirements.

A 2-year ornamental horticulture technology program has certain unique requirements that influence the content and organization of the curriculum for each option. Some requirements are imposed by the occupational functions that graduates are expected to perform; some result from the trade's emphasis on particular areas of ornamental horticulture; some may be incidental to the need for content that maximizes the effectiveness of teachers who have special competencies; and others result from the limited time available to produce a competent technician in such a new field. This guide reflects three basic requirements: functional utility, units of instruction in specialized technical subjects, and provisions for teaching principles by application.

The sequence of courses in 2-year technical curriculums is as important as course content if the limited time is to be used effectively. In general, the subject matter is carefully coordinated in groups of concurrent courses to provide the student with basic principles which broaden his scope of understanding in the many areas of ornamental horticulture. This is in sharp contrast to the arrangement of the usual professional curriculum in which basic and somewhat unrelated courses make up the first part of the study program and specialization is deferred to subsequent terms.

The relationship between laboratory time and class lecture or discussion and study time is of great importance in a technical education curriculum. The necessary theory, skills, techniques, understanding of applied principles, and knowledge of processes and equipment could be taught in the laboratory without the classroom theory. The converse is not true. Laboratory experience, skills, know-how and capability, which are characteristic attributes of technicians, cannot be acquired in classrooms without coordinated laboratory classes. However, organized and related ideas, concepts, and factual information can be taught in "theory" classes by demonstration and other visual aids, use of selected texts and references, and required assignments and systematic outside study on the part of students. Group teaching usually makes more efficient use of the instructor's time in a "theory" class than in a laboratory and emphasizes development of the student's skills in obtaining knowledge from printed sources. Thus, there must be a special relationship between the amount of the scientific and technical specialty taught in the "theory" classes and that taught in the laboratory.

Each curriculum provides a substantial apportionment of time to laboratory hours in ornamental horticulture during the first two semesters because introductory and elementary laboratory skills and knowledge of growing plants, and of tools, processes, materials, devices, and good laboratory practice can (and should) be learned early. Elementary laboratory work can be started without much underlying theory. As the underlying theory is developed and understood, it can be incorporated into the laboratory work. The laboratory then becomes a significant experience for teaching each subject in greater depth.

In technical curriculums it is important that specialized technical course work be introduced in the first semester. Deferring this introduction, even for one term, imposes serious limitations on the effectiveness of the curriculum. Several advantages occur from an early introduction to the technical specialty:

1. The student enrolled in ornamental horticulture starts his training immediately in this speciality. If the first semester consists entirely of general subjects—mathematics, English, social studies—students often lose interest.

2. By introducing the technical specialty in the first semester it is possible to achieve greater depth of understanding in specialized subjects in the later stages of the 2-year program.

3. The student sees the relationship between the general education courses and the ornamental horticulture course work.

Safety and careful workmanship must be a central theme throughout the course of study because the technician's work often involves potential dangers. With careful work procedures, an understanding of the equipment, and normal safety practices, accidents on the job can be avoided. In addition to protecting human life, practice of careful workmanship will protect delicate plants and the expensive equipment used by the horticulturist.

The course outlines in this guide are short and descriptive. The individual instructor will have to prepare complete courses of study and arrange the curriculum material to suit his particular teaching program. Suggested laboratory layouts and equipment found in the "Facilities, Equipment, and Costs" section may help in organizing the program. The subjects of specialization are introduced in the first semester in close correlation with other subject matter.

During the first semester *Horticultural Soils* and *Horticultural Applications* introduce technical information and experiences fundamental to all horticulture, and particularly applicable to any of the five options offered here. *Botany* introduces the basic biological science which underlies the technical speciality early in the first semester. Students begin to learn the application of botanical principles to their field of special interest. The course in *Horticultural Applications* emphasizes the relationship between the basic science and horticultural specialization.

Chemistry provides a basis for understanding the fundamental processes in the growth and health of plants, and teaches the underlying principles of chemical behavior necessary to understand the use of fertilizers, pesticides, and other agricultural chemicals so important to the horticulturalist.

Mathematics in the first semester supports and adds depth to the chemistry course. The objective of the course is to provide students with an understanding of the various scientific, technical, or business applications in ornamental horticultural operations.

The first semester courses are the same for all five options. Thus students have a chance to discover their interests and change curriculums (if more than one is offered) after consultation with the faculty. The first semester in a college level program is a critical period in the life of all students, so content and instruction should be carefully planned and executed. Students will need maximum encouragement from each instructor to help them become adjusted to the rigors of the program. Those who find the study demands greater than expected should receive special attention.

The second semester introduces the student to horticultural courses which prepare him for the specialized courses offered during the second year.

The occupational experience gained in the summer session is most important because it provides the student an opportunity for observation and the application of skills learned in the first year. During the summer session, the faculty should keep in close contact with the student worker and his employer. Progress reports from students add depth to the work experience.

Study of agricultural chemicals, fertilizers, pesticides, and herbicides used in the field of ornamental horticulture are incorporated in the several course outlines where pertinent. This provides the individual instructor some latitude for varying his emphasis to suit geographical sections and the field of specialization. Instructors should be alert to the new agricultural chemicals and add these to the course content when appropriate.

The second year courses in all of the options provide further depth in understanding and applying scientific principles as well as a higher degree of specialization. The extensive laboratory work for the technical specialty courses provides the experiences and learning environment to develop and exercise special techniques, methods, practices, and procedures which identify the field of specialization. Special problems and projects which require the application of what has been learned in previous courses are a part of the second year technical specialty courses.

The *Social Science* courses are designed to broaden the student's concepts and perception of the society in which he lives and will be employed. These courses include broad economic and industrial concepts, and sufficient emphasis on corporate structure and economics to enable the student to comprehend the terminology and recognize the motives, methods, objectives, and administrative procedures of employers. Close correlation of concurrent courses continue to be stressed in the third and fourth semester courses.

Communication Skills emphasize the mechanics of reading, writing, listening, speaking, and reporting early in the curriculum. These skills are reinforced by *Technical Reporting* in the second semester. Instructors in technical courses should set increasingly high standards of clarity, text, and neatness for student work in reporting. Freedom to report on ornamental horticulture subjects of their own choosing may add reality and extra motivation. In a 2-year program the standards of reporting should approach those required by business organizations. At the same time instructors should encourage individual style and initiative by allowing as much freedom as possible in reporting, consistent with established school standards.

The course outlines included in this guide are concise and comprehensive, intended as guides rather than as specific plans of instruction to be covered in an inflexible order or sequence. They represent a judgment on the relative importance of each instructional unit, especially where time estimates are shown for the divisions within each course. It is expected that the principles outlined in these courses will be supplemented with *Horticultural Applications* whenever applicable. Field trips add greatly to the effectiveness of the instruction if they are carefully planned in advance so that the processes observed relate to the unit being studied at the time of the trip.

Outside study assignments are a significant part of the student's total program. In this curriculum, 2 hours of outside study have been suggested for each hour of scheduled class time. During the first semester, a typical weekly work schedule would total 56 hours: class time, 15 hours; outside study, 30 hours; laboratory, 11 hours. This is a full schedule but not an excessive one for this type of program.

No examinations have been scheduled in the semester outlines which are designed for 16 weeks. However, a 17-week semester is assumed to provide time for examinations. The primary objectives of examinations are to evaluate the student's knowledge and allow him the opportunity for a periodic comprehensive review of the course material. Results of examinations also may point out weaknesses in teaching techniques or subject units.

Although this guide is intended for program planning and development in post high school institutions, it can be adapted to suit the needs of several kinds of schools. The level of instruction represents a consensus on the proficiency level required for success in horticultural occupations where manpower is in short supply and will perhaps become acute in the future.

The program is not intended to make the individual proficient in all of the duties he might be asked to perform because proficiency in work of a highly specialized nature comes with practice and experience. It is impossible to forecast the exact requirements and to predict accurately the course needs or rate of change in requirements for ornamental horticulture. Employers generally recognize that recent graduates need a year or more of work experience to orient themselves to their responsibilities and role in an organization. Furthermore, the productive graduate technician in ornamental horticulture will continue to study throughout his career in an effort to realize his full potential.

Suggested Continuing Study

A 2-year curriculum must concentrate on providing the necessary mathematics, science, and related knowledge and skills in the technical specialty if it is to produce graduates who can qualify for employment.

Obviously a 2-year program in ornamental horticulture cannot cover in depth all of the subjects which are pertinent to the technology; important related subjects may only be touched upon at that time. In addition the graduate may obtain work in an area so new that adequate coverage in the training program has not yet been developed.

For these reasons some form of continuing study for graduates of ornamental horticulture technology programs is therefore desirable. By reading the current literature related to ornamental horticulture, by scientific and technical society activity, and by study on his job, the student can keep abreast of the technical developments in his special field. However, such study tends to build on the organized technological base provided by the curriculum he followed. Formal continuation of supplementary courses provides the most efficient and practical means for the graduate technician to add important related areas of knowledge and skill to broaden the base of his initial education. Formal study offers the advantages of systematically arranged subject matter and class discussion. The courses may be scheduled for evening or after work hours on Saturday.

Some employed technicians may enroll in botany, mathematics, accounting, business, and other formal courses offered in evening programs at community colleges and technical institutes.

Continued study through extension courses, or informal study might include the following subjects:

Any of the courses or subjects shown in the options which the student did not study
Agricultural chemicals and their use (advanced study)
Botany (advanced)
Business management
Chemistry (advanced)
Cost accounting
Genetics applied to plant propagation or development of new varieties of plants
Industrial supervision and human relations
Instrumentation and automatic control

COURSE OUTLINES

The course outlines suggest the content which might be taught in the curriculum and provide practical and attainable coverage of the field. The units of instruction have been reviewed by instructors in ornamental horticulture programs and by representatives of employers who require the services of skilled ornamental horticulturists.

Some modification of content is expected to meet the needs defined by local advisory committees and to use effectively the special interests and capabilities of teaching staffs. However, the implied level, quality, and completeness of the program should not be compromised.

At the end of each course is a list of texts and references. These lists should be analyzed for content and pertinency, and current editions should be substituted and new books added. The information needed for courses in ornamental horticulture curriculums, particularly the technical specialty courses, is seldom available in one textbook; hence several are listed. The lists could be augmented considerably with current materials from manufacturers, trade journals, technical societies, and suppliers of apparatus and services in the option studied.

A list of suggested visual aids is offered for many courses. A visual aid should be used when pertinent, and when its use serves as an effective teaching method. *Instructors should avoid the excessive use of films to replace well prepared lecturers and demonstrations.*

Undoubtedly, the experienced instructor will use charts, slides, models, samples, and specimens liberally to illustrate special technical aspects of the subject. These aids are usually accumulated by the experienced instructor from previous laboratory or lecture preparations and should be updated when new developments occur.

The laboratory sessions suggested in the curriculum outlines and the course descriptions are not necessarily intended to be single sessions, but rather the total hours of laboratory sessions per week. The sessions should be scheduled in reasonable and effective increments. For example, a 6-hour laboratory period might be scheduled as three 2-hour sessions or two 3-hour sessions per week, or other divisions of laboratory time that seem appropriate may be arranged according to classroom instruction and the season or time of year.

DRAINAGE AND IRRIGATION

Hours Required

Class, 2; Laboratory, 3

Course Description

This course is concerned with the development of turfgrass; emphasis is on drainage and irrigation principles and water requirements.

The efficiencies of various irrigation concepts are discussed as they pertain to terrain, soils, climate, and the plants being grown. Water sources, availability, and storage are taught along with pressure requirements and means of conveyance. When and how to irrigate and rate of application are discussed in relation to soils and terrain. The legal aspects of irrigation, which vary throughout the country, are examined. General guides are presented so that students will be aware of local regulations and understand the significance of these regulations.

The relief of waterlogged soils is covered in detail. Surface and subsurface techniques are explained and demonstrated; social and economic aspects of the use of water are emphasized.

Major Divisions

	Class Hours
I. Introduction and Scope of Irrigation	2
II. Drainage	9
III. Irrigation	11
IV. Pumps	5
V. Sources of Power	5
Total	32

Units of Instruction

I. Introduction and Scope of Irrigation
- A. History
  - 1. The beginning
  - 2. Egypt
  - 3. China
  - 4. Spain
  - 5. Mexico
  - 6. United States
- B. Importance of irrigation
- C. Definition
- D. Methods of accomplishment
- E. Frequency, rate and intensity of application
- F. Scope
- G. Economics

II. Drainage
- A. Effects of poor drainage
  - 1. Reduces time of area usage
  - 2. Shortens growing time of grass
  - 3. Freezing causes honeycombing and heaving
  - 4. Causes shallow root systems
  - 5. Destroys soil structure
  - 6. Encourages soil acidity
  - 7. Reduce action of beneficial soil organisms
  - 8. Prevents leaching of toxic dissolved salts
- B. Factors determining drainage requirements
  - 1. Wet, soggy soil and ponds
  - 2. Presence of moisture tolerant grasses and other plants
  - 3. Baker soils when dry
  - 4. Honeycombed frozen soil
  - 5. Blue or mottled subsoil
  - 6. Shallow root system
  - 7. Weak, thin turf
  - 8. Presence of mosses
- C. Factors affecting surface drainage
  - 1. Standing water
  - 2. Compaction
  - 3. Poor contouring
  - 4. Aquatic plant life
  - 5. Algae and mosses
  - 6. Offcolor or yellow plants as indicators
- D. Subsurface drainage
  - 1. Continuously wet soils
  - 2. Systems
    - a. Tile lines
    - b. Open trenches
    - c. Subsoil plowing or knifing
- E. Tile systems
  - 1. Regular
    - a. Gridiron
    - b. Herringbone
    - c. Random
  - 2. Intercepting
    - a. Foot of slopes
    - b. Along slopes
- F. Installation of tile systems
  - 1. System choice
  - 2. Tile spacing
  - 3. Depth
  - 4. Grade

5. Alinement
6. Outlets, joints and openings
7. Backfill material
8. Plan of location and design

- G. Other methods of drainage
  1. Open ditches and swales
  2. Catch basins and sink soles
  3. Mole drains
- H. Surface drainage of greens and tees
  1. Poor contouring
  2. Compaction
  3. Impervious subsoil
  4. Seepage
  5. Poor location of shrub and tree vegetation
  6. Broad and gradual contour changes (at least 1%)
  7. Drain away from concentrated traffic
  8. Reconstruction often required (expensive)
- I. Underdrainage of greens and tees
  1. Consider when constructing each green and tee
  2. Minimum tile size 4″
  3. Minimum depth 24″—30″
  4. Slope trench sides in subgrade
  5. Backfill with porous material (cinders) to 8″—10″ surface
  6. Space 10′—25′
  7. Remove water beyond green or tee area to a ditch, creek, or catch basin
  8. U.S.G.A. Green Section method (outlined in *Turf Management*, by H. B. Musser)
- J. Drainage corrections on established greens and tees
  1. Correct diagnosis
  2. Choice of method
- K. Fairway drainage
  1. Similar to greens
  2. Area size problems usually localized (because of)
  3. When entire fairway is involved (often corrected by simplest system)
- L. Drainage of traps
  1. Design of trap contours
  2. Tile drains

III. Irrigation

- A. Functions
  1. Solvent and carrier
  2. Digestion of raw materials
  3. Regulation of rate of food manufacturing
  4. Equalization of temperature
  5. Development and activity of organisms
- B. Quantities necessary
  1. Requirements of various grasses
  2. Soil and weather conditions
  3. Sod density
  4. Height of mowing cut
  5. Depth of roots
- C. Soil conditions affecting availability and retention
  1. Capillary satisfaction
     - a. Sandy soil ¾″—1″ water soaks to a depth of 6″ into soil
     - b. Loam soil 1″—1¾″ water soaks to a depth of 6″ into soil
     - c. Clay soil 1¾″—2½″ water soaks to a depth of 6″ into soil
  2. Losses
     - a. Runoff
     - b. Percolation
     - c. Evaporation
- D. Determination of water requirements
  1. Fixed standard (none)
  2. Requirements (variable)
  3. Available data on temperature and rainfall
  4. Average rainfall and time between rainfalls
  5. Wind velocities
  6. Clear or overcast
  7. Humidity
  8. Applicable systems
- E. Irrigation systems
  1. Sprinkler type
  2. Surface flooding
  3. Subsurface flooding
- F. Sprinkler systems
  1. Adequate water supply
  2. Suitable pressure (pump)
  3. Transmission lines
  4. Equipment for distribution
- G. Sources of water
  1. Municipal systems
  2. Wells
  3. Lakes, ponds, and streams
- H. Pressure equipment
  1. Centrifugal pumps
  2. Displacement pumps
  3. Turbine pumps

- I. Pipe lines
  - 1. Volume
  - 2. Head pressure
  - 3. Friction losses
  - 4. Materials
    - a. Metal
    - b. Plastic
  - 5. Layout of system
- J. Sprinkler heads
  - 1. Fixed
  - 2. Whirling
  - 3. Slow-revolving (impact)
  - 4. Capacity of head
    - a. Size of nozzle
    - b. Type of nozzle
    - c. Water pressure (at nozzle)
- K. Types of systems
  - 1. Surface lines (manual)
  - 2. Underground (rotating, pop-up, and combinations)
    - a. Semiautomatic
    - b. Completely automatic
    - c. Quick-coupler (snap valves)
- L. Planning the system
  - 1. Complete plan on paper by *professional*
  - 2. Minimum length of piping, fittings and heads
- M. Surface flooding
  - 1. Limitations
  - 2. Applications
- N. Subsurface irrigation
  - 1. Limited to adaptable soil conditions
  - 2. Applications
- O. Water management
  - 1. New seedings and vegetative plantings
    - a. Fine spray
    - b. Control to avoid soil washing
    - c. Avoid saturation of soil
  - 2. Watering greens and tees
    - a. Quantity
    - b. Frequency and rate
    - c. Effect on disease
    - d. Time of watering
    - e. Prevention of wilt
    - f. Prevention of winter drying
    - g. Other seasonal factors
  - 3. Watering fairways
    - a. Similarity to greens and tees
    - b. Grass species a determining factor
    - c. Seasonal adjustments
    - d. Soil quality and surface drainage
    - e. Water and fertilizer relationships

- IV. Pumps
  - A. Types of pumps
    - 1. Displacement
    - 2. Centrifugal
    - 3. Turbine
  - B. Pump characteristics
  - C. Power requirements
    - 1. Foot pounds per second
    - 2. Horsepower
  - D. Pumping lifts
  - E. Friction loss
  - F. Efficiency of pumping plants
- V. Sources of Power
  - A. Considerations
    - 1. Horsepower
    - 2. Dependability
    - 3. Availability and cost of energy
    - 4. Initial cost
    - 5. Depreciation
    - 6. Portability
    - 7. Maintenance
    - 8. Simplicity of operation
    - 9. Quality of labor required
  - B. Electric motors
    - 1. Choice of phase
      - a. Single phase
      - b. Three phase
    - 2. Speed
    - 3. Service costs
      - a. Low energy and continuous use
      - b. High energy and short time use
      - c. Kilowatt hour cost
  - C. Internal combustion engines
    - 1. General types
      - a. Gasoline
      - b. Diesel
    - 2. Costs
      - a. Initial
      - b. Operating
    - 3. Efficiency
      - a. Less than 7½ h.p.
      - b. More than 7½ h.p.

Recommended Laboratory Projects—48 hours

- I. Plan and construct a shallow tile drainage system using clay tile or compressed asphalt composition material (15 hours).
- II. Plan and install a subsurface sprinkler irrigation system with various types of

sprinkler heads and couplings (18 hours).

III. Provide the students with the opportunity to work with various types of pumps (9 hours).

IV. Take field trips to a golf course and sod farm to study drainage and irrigation facilities (6 hours).

Texts and References

ISRAELSEN *and* HANSEN. *Irrigation Principles and Practices.*

MUSSER. *Turf Management.*

Instructional Aids

Demonstrations of equipment
Slides, 35 mm.

FLORAL DESIGN

Hours Required

Class, 1; Laboratory, 3

Course Description

This course introduces the basic principles of floral design; the art of arranging flowers for the home and flower shows; commercial designs for personal adornment, arrangements for the sick, and for other uses or occasions.

Major Divisions

	Class Hours
I. Introduction	1
II. The Art of Floral Arrangements	3
III. Vases—Pottery and Containers	2
IV. Flower Holders and Uses	1
V. Basic Principles in Desgin	4
VI. Flowers and Their Lasting Qualities	1
VII. Dried and Winter Arrangements	3
VIII. The Corsage and Boutonniere	1
Total	16

Units of Instruction

- I. Introduction
  - A. Floral art and modern living
  - B. Flowers in the home
  - C. Flower compositions on the show table
  - D. Instructor's part in the course
  - E. How the student's grade is determined
- II. The Art of Floral Arrangements
  - A. Basic designs
  - B. Triangle
  - C. Horizontal
  - D. Line arrangements

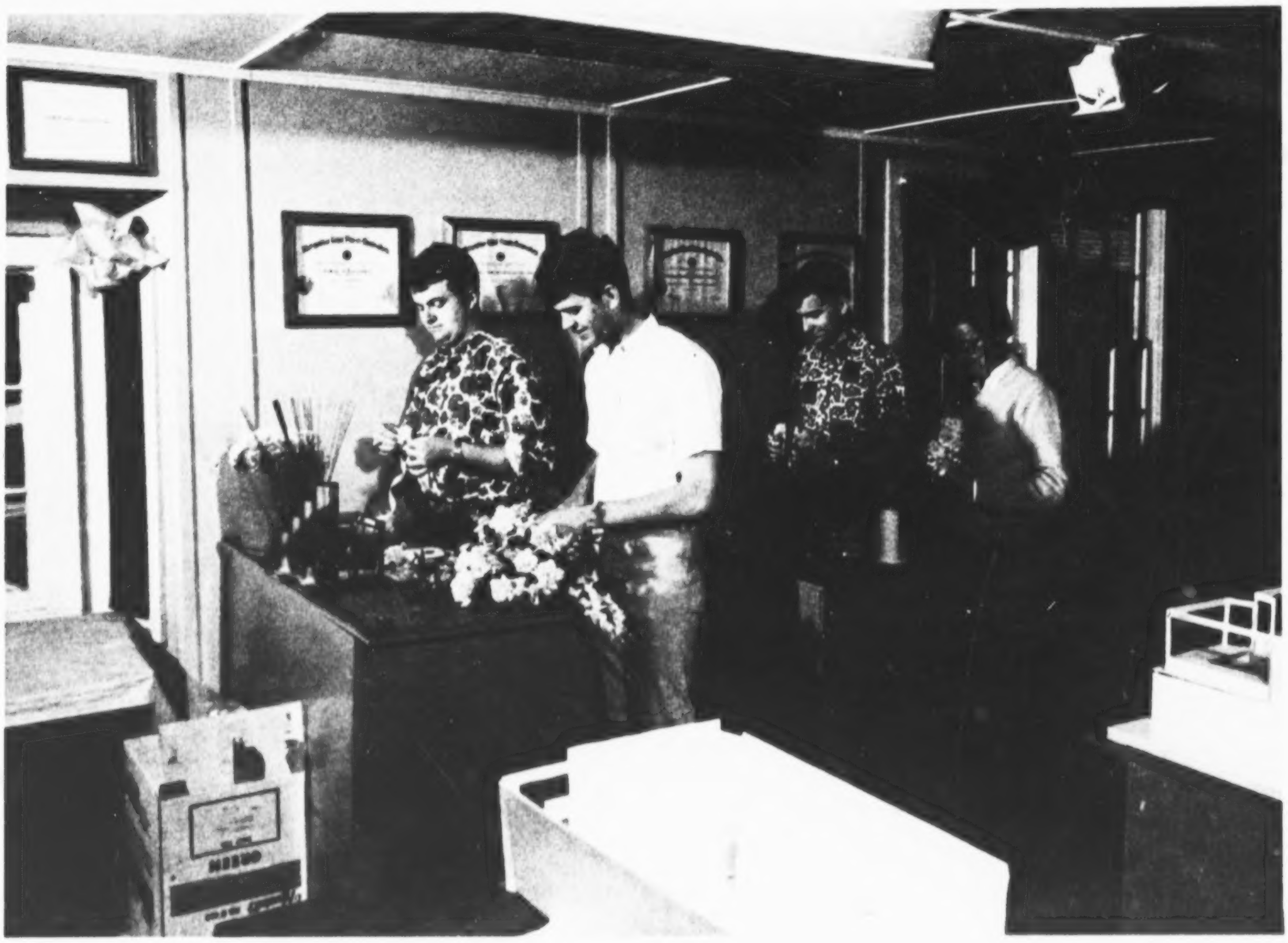

Figure 12.—Facilities for a floral design course should have ample work space. The materials and accessories for designing, making, and displaying floral pieces should be comparable to those used by modern florists so that a student can work as if he were an employee.

- E. Japanese
- F. Mass-Victorian arrangements

III. Vases—Pottery and Containers
- A. Selection of vases
- B. Practicability, water holding capability and stability
- C. Pottery, glass, pewter, wood, silver, brass, copper, and plastic
- D. Household utensils, cups, teapot, tea kettle, and serving dishes

IV. Flower Holders
- A. Metal dome types—birdcage
- B. Needle—pinpoint
- C. Plastic holders
- D. Art clips—posey clay and tape
- E. Oasis, snowpack, vermiculite, shredded styrofoam

V. Basic Principles in Design
- A. Harmony, balance, focus
- B. Proportions, dimensions
- C. Composition

VI. Flowers and Their Lasting Qualities
- A. Age and stage of development
- B. Time of harvest
- C. Conditioning, warm water, refrigeration
- D. Flower preservatives
- E. Temperature and drafts

VII. Dried and Winter Arrangements
- A. Dried wild flowers and weeds
- B. Seed pods of flower and woody plants
- C. Forced twigs of shrubs and fruits
- D. Foliage, fruit, nuts, gourds, and corn

VIII. The Corsage and Boutonniere
- A. Formal, street wear, novelties
- B. Selection of flowers
- C. Ribbons and accessories
- D. Lasting qualities
- E. Packaging, deliveries
- F. A man's flower

Recommended Laboratory Projects—48 hours

At each laboratory session the student will have a definite assignment. He will design various arrangements using fresh flowers and greens. After this he will then have a chance to create arrangements and develop his own floral artistry. Competition in flower shows affords a very rewarding experience. Laboratory work should include the design and preparation of:

- I. A symmetrical arrangement (3 hours).
- II. An asymmetrical arrangement (9 hours).
- III. A line arrangement (6 hours).
- IV. A Victorian arrangement (3 hours).
- V. A table centerpiece (6 hours).
- VI. A Thanksgiving centerpiece (6 hours).
- VII. A Christmas centerpiece (3 hours).
- VIII. Evergreen Christmas decorations (3 hours).
- IX. A winter arrangement using dried materials (3 hours).
- X. An informal corsage (3 hours).
- XI. A formal corsage (3 hours).

Texts and References

Berrall. *A History of Flower Arrangement.*
Liesveld. *The Retail Florist.*
Squires. *The Art of Drying Plants and Flowers.*
Thompson. *The Driftwood Book.*
Wilson. *Color in Flower Arrangement.*

Instructional Aids

Greenhouses
Plastic structures
Display window
Flower refrigerator
Kodachrome slides
Projector and screen
Commercial journals
Catalogs

FLORICULTURE

Hours Required

Class, 1; Laboratory, 4

Course Description

This course provides an opportunity for each student to develop initiative and acquire knowledge, skills, and judgment in producing flowers by formal study and greenhouse laboratory exercises in growing flowers under glass, in plastic structures, and outdoors.

Students become familiar with the most recent and efficient methods for planning and evaluating production of potted plants and cut flowers, with the profit motive as the underlying criterion.

Major Divisions

	Class Hours
I. Introduction	1
II. Methods of Watering	2
III. Temperature Control	2
IV. Use of Equipment	2
V. Soil Preparation	2
VI. Handling of Seedlings	2
VII. Planning a Schedule for Bedding Plants	2
VIII. Field Culture of Azaleas and Gladioli	3
Total	16

Units of Instruction

I. Introduction
  A. Operation of greenhouses
  B. Use of cold frames
  C. Storage facilities for tools, machinery, and fertilizers

II. Methods of Watering
  A. Watering pots
  B. Hose
  C. E-Flowmatic
  D. Gates system
  E. Injection method
  F. Misting
  G. Water supply considerations

III. Temperature Control
  A. Type of ventilation
  B. Manual
  C. Mechanical
  D. Adjustments
  E. Cooling methods
  F. Cold frame

IV. Use of Equipment
  A. Rototiller
  B. Greenhouse sprayers
  C. Soil sterilizers
  D. Soil shredders

V. Soil Preparation
  A. Soil test
  B. Conditioning
  C. Organic additions
  D. Fertilizer
  E. Sterilizing

VI. Handling of Seedlings
  A. Pricking off
  B. Flats, market packs
  C. Clay, jiffy pots
  D. Soil mixtures and blends
  E. Number of plants per unit

VII. Planning a Schedule for Bedding Plants
  A. Sowing date
  B. Quantity of seed
  C. Schedule transplanting date
  D. Schedule time of bloom
  E. Marketing

VIII. Field Culture of Azaleas and Gladioli
  A. Soil preparation
  B. Soil fertility factors
  C. Distance of planting
  D. Labeling, inventory
  E. Weed killers
  F. Summer care
  G. Pinching and pruning
  H. Insect control

Recommended Laboratory Projects—64 hours

I. Practice different methods of watering (8 hours).
II. Evaluate moisture content in soil (2 hours).
III. Open and close ventilators (4 hours).
IV. Maintain humidity by syringing and misting (2 hours).
V. Amend and mix soil (4 hours).
VI. Sterilize soil (2 hours).
VII. Fill market packs (8 hours).
VIII. Sow seeds of bedding plants (4 hours).
IX. Prick off seedlings (4 hours).
X. Pot transplants into 2¼″ to 4″ pots (4 hours).
XI. Place plants on raised benches (2 hours).

XII. Pinch plants as needed (4 hours).
XIII. Prepare soil and field for azalea plants (4 hours).
XIV. Plant azaleas (4 hours).
XV. Prepare field for planting gladioli (4 hours).
XVI. Plant gladioli (4 hours).

Texts and References

BALL. *The Ball Red Book.*

Instructional Aids

Fields
Greenhouse
Growing facilities

FLOWER SHOP OPERATION

Hours Required

Class, 2; Laboratory, 3

Course Description

This course, a continuation of Floral Design, introduces the retail florist business. It includes an analysis of the development management, operation, and sidelines. Students learn the general principles of commercial floral designs through practice.

Major Divisions

	Class Hours
I. Population and Neighboring Business Establishments	2
II. Retail Grower and Retail Florist	2
III. Location	2
IV. Ownership	3
V. Utilities	2
VI. Qualifications and Owner-Manager	2
VII. Designing and Sales Help	2
VIII. Deliveries	2
IX. Wedding Flowers	3
X. Decorations	2
XI. Funeral Designs	3
XII. Flower Arrangements	3
XIII. Flowering and Green Plants	2
XIV. Sidelines	1
XV. Personnel and Factors Affecting Morale	1
Total	32

Units of Instruction

I. Population and Neighboring Business Establishments
  A. Size of city and population
  B. Urban or rural
  C. Economy of people
  D. Residential or industrial
  E. Other business establishments

II. Retail Grower and Retail Florist
  A. Greenhouses
  B. Flower shop and the sales area
  C. Production for retail only
  D. Selection of crops
  E. The retail florist shop

III. Location
  A. City, main avenue, or side street
  B. Shopping center
  C. Hotels and transportation centers
  D. Urban
  E. Rural, roadside

IV. Ownership
  A. Rental
  B. Rental with option to buy
  C. Outright purchase
  D. Starting a new establishment
  E. Name, surname after flower or town
  F. Partnership or corporation
  G. Legal counsel, appraisal, certified public accountant
  H. City and town ordinances

V. Utilities
  A. Heating
  B. Air conditioning
  C. Water
  D. Lighting

VI. Qualifications and Owner-Manager
  A. Ability, floral art and designing
  B. Sales
  C. Management of personnel
  D. Buying and inventory
  E. Business and office procedure

VII. Designing and Sales Help
  A. Male and female
  B. Experience related to salary
  C. Appearance and personality
  D. Compatability

VIII. Deliveries
  A. Truck or station wagon
  B. Color and lettering
  C. Delivery boys and drivers
  D. Receipts (cash-on-delivery or other payment plan)
  E. Special deliveries

IX. Wedding Flowers
  A. Recommendations and selection
  B. Bride's bouquet
  C. Maid of honor and bridesmaids
  D. Flower girl or boy
  E. Mother's and father's flowers
  F. Boutonnieres
  G. Delivery to home or church
  H. Billing (deposit, charge, or cash-on-delivery)

X. Decorations
  A. Church, home, or hotel
  B. Public functions, stage or ballroom

- C. Banquet table
- D. Bar Mitzvah
- E. Props and background
- F. Cut flowers, plants and/or greens
- G. Rental of floral pieces

XI. Funeral Designs
- A. Values and reasons
- B. Types of design
- C. Standing pieces
- D. Baskets and sprays
- E. Casket covers
- F. Oasis and aquapicks
- G. Card or message
- H. Funeral directors

XII. Flower Arrangements
- A. Hospital (illness or maternity)
- B. Home
- C. Novelty, holiday or gift
- D. Table flowers
- E. Holders and fillers
- F. Wrapping and delivery

XIII. Flowering and Green Plants
- A. Green plants the year round
- B. Dish gardens and planters
- C. Flowering and holiday plants
- D. Selection and buying of stock
- E. Care of plants and cultural directions

XIV. Sidelines
- A. Greeting cards
- B. Books on floral arrangement
- C. Tropical fish and aquariums
- D. Pottery, vases and flower holders
- E. Seeds and bulbs

XV. Personnel and Factors Affecting Morale
- A. Authority and supervision
- B. Personal conduct
- C. Hours, regular and weekends
- D. Group insurance
- E. Paid vacations
- F. Incentive bonuses

Recommended Laboratory Projects—96 hours

Each student has a definite assignment at each laboratory session. He designs arrangements and floral pieces for all occasions, creates arrangements, and develops floral artistry. He uses fresh flowers and greens, as well as dried flowers that last. Attendance at flower shows and demonstrations broadens the student's knowledge.

I. Design floral gifts, including:
- A. A hospital arrangement (6 hours).
- B. A baby novelty (3 hours).
- C. A birthday arrangement (3 hours).
- D. An anniversary arrangement (3 hours).
- E. A novelty arrangement (3 hours).
- F. A bread and butter arrangement (3 hours).

II. Design flowers for personal adornment, including:
- A. A nosegay and boutonniere (3 hours).
- B. Orchid corsages (6 hours).
- C. A wristlet of roses (3 hours).
- D. Novelty corsages for St. Patrick's Day or St. Valentine's Day (6 hours).

III. Design wedding flowers
- A. Design an arm bouquet (3 hours).
- B. Design a cascade bouquet on a holder (6 hours).
- C. A cascade bouquet tied (6 hours).
- D. A colonial bouquet (3 hours).
- E. A crescent bouquet (3 hours).
- F. A prayer book bouquet (3 hours).

IV. Design floral tributes for a funeral, including:
- A. A spray (6 hours).
- B. A wreath (3 hours).
- C. A pillow (3 hours).
- D. A cross (3 hours).
- E. A heart (3 hours).
- F. A basket (6 hours).
- G. A casket cover (6 hours).
- H. Standing baskets (3 hours).

Texts and References

BALL. *The Ball Red Book.*
BERRALL. *A History of Flower Arrangement.*
LAURIE, KIPLINGER, *and* NELSON. *Commercial Flower Forcing.*
LIESVELD. *The Retail Florist.*
WILSON. *Color in Flower Arrangement.*
Trade Publications:
Florist and Nursery Exchange.
Florists' Review.
Growers' Talks.

Instructional Aids

Kodachrome slides
Pictures of designs

GREENHOUSE OPERATIONS I

Hours Required

Class, 2; Laboratory, 6

Course Description

A study of the status of the flower growing industry, including recent expansion and future possibilities. This course focuses on the development of the industry, locations, plans, facilities, marketing and statistics vital to the modern producer of cut flowers and plants grown under glass. The laboratory exercises provide practice in growing flowers and plants in a greenhouse.

Major Divisions

	Class Hours
I. Development of the Flower Growing Industry	2
II. Selecting a Location and the Importance of a Master Plan	9
III. Greenhouse and Other Plant Growing Structures	6
IV. Methods of Heating, Fuels, Refrigeration, and Sterilization	7
V. Statistics on National and Regional Cut Flowers and Plant Production	3
VI. Marketing and Transportation	5
Total	32

Units of Instruction

I. Development of the Flower Growing Industry
  A. Statistics of the growth of the industry
  B. Population trends and changes
  C. Economics and the flower buying public

II. Selecting a Location and the Importance of a Master Plan
  A. Climatic environment and its influence on plant growth
  B. Cost of land, appraisal and legal advice
  C. Available transportation systems and their importance
  D. Planning facilities
    1. Land
    2. Master plan for buildings
    3. Roads and parking
    4. Future expansion
  E. Labor market
    1. Agricultural and industrial
    2. Skilled and unskilled
  F. Taxation and its influence on production cost
  G. Water supply
    1. Public
    2. Private

III. Greenhouse and Other Plant Growing Structures
  A. Unit arrangement
    1. Single unit
    2. Ridge
    3. Furrow style
  B. Type of construction
    1. Iron
    2. Semisteel
    3. Aluminum
  C. Plastic Greenhouses
    1. Polyethylene
    2. Weatherable mylar
    3. Rigid plastics (filon, corrulux)
  D. Benches
    1. Ground V-bottom
    2. Raised concrete
    3. Transits
    4. Redwood
    5. Wire mesh
  E. Hot beds and cold frames

IV. Methods of Heating, Fuels, Refrigeration and Sterilization
  A. Boilers—section, tubular
  B. Steam, hot water and hot air
  C. Radiation iron heating
    1. Coils
    2. Fin-type radiation
    3. Blowers
  D. Fuels
    1. Oil
    2. Coal
    3. Gas
  E. Storage Refrigeration
    1. Air
    2. Water-cooled compressors
  F. Steam boiler or portable boiler for sterilization

V. Statistics for National and Regional Cut Flower and Plant Production
  A. U.S. Department of Commerce census of agriculture
  B. Surveys by national and regional trade associations
  C. Market reports
    1. State
    2. Trade journals

VI. Marketing and Transportation
  A. Major markets along eastern seaboard
  B. Midwest
  C. South and West
  D. Shipping containers
    1. Packaging
    2. Hampers
    3. Corrugated boxes
    4. Wooden boxes
  E. Condition of product
    1. Dry
    2. In water
    3. Iced
  F. Transportation cost
    1. Railroad
    2. Truck
    3. Air
  G. Shipments
    1. Direct to consumer
    2. Bonded wholesale commission merchant
    3. Retail florist

Recommended Laboratory Projects—96 hours

I. Prepare greenhouse soil (9 hours).
II. Sterilize greenhouse soil (6 hours).
III. Seed greenhouse crops (3 hours).
IV. Make cuttings (6 hours).
V. Pot and transplant (18 hours).
VI. Support and stake greenhouse crops (6 hours).
VII. Harvest greenhouse crops (18 hours).
VIII. Ventilate greenhouses (3 hours).
IX. Control heat in greenhouses (3 hours).
X. Water greenhouse crops (18 hours).
XI. Syringe greenhouse crops (3 hours).
XII. Glaze and paint greenhouse (3 hours).

Texts and References

BALL. *The Ball Red Book.*

LAURIE, KIPLINGER, *and* NELSON. *Commercial Flower Forcing. Flower and Plant Production in the Greenhouse.*

LAURIE *and* RIES. *Floriculture Fundamentals and Practices.*

POST. *Florist Crop Production.*

Trade Publications:
  Florist and Nursery Exchange.
  Florists' Review.
  Growers' Talks.
  New York State Flower Growers' Bulletin.

Instructional Aids

Kodachrome slides
Charts
Greenhouse plans

GREENHOUSE OPERATIONS II

Hours Required

Class, 2; Laboratory, 6

Course Description

This course is a continuation of Greenhouse Operations I. Study of commercial flower production under glass (greenhouse), plastic houses, and out-of-doors; cultural and technical requirements; modern production methods and applications. Extensive laboratory practice is provided in the various operations in greenhouse plant production.

Major Divisions

	Class Hours
I. Cut Flower Production	1
II. Commercial Rose (*Rosa hybrida*) Production	3
III. Chrysanthemum (*Chrysanthemum morifolium*) Cut Flower Production	3
IV. Carnation (*Dianthus caryophyllus*) Cut Flower Production	3
V. Snapdragon (*Antirrhinum majus*) Cut Flower Production	2
VI. Stocks (*Matthiola incana*) Cut Flower Production	1
VII. Sweet Pea (*Lathyrus odoratus*) Cut Flower Production	1
VIII. Gardenia (*Gardenia grandiflora*) Cut Flower Production	1
IX. Production of Potted Flowering Plants	17
Total	32

Units of Instruction

I. Cut Flower Production
  A. Cost of production
    1. Labor
    2. Overhead expenses
  B. Selection of crop to be grown
    1. Suitable facilities
    2. Commercial value

II. Commercial Rose (*Rosa hybrida*) Production
  A. Propagation
    1. Cuttings
    2. Grafting
    3. Budding
    4. Stock plants
  B. Buying young plants
    1. Started buds
    2. Dormant buds
    3. Grade
  C. Soil preparation
    1. Soil type
    2. Organic matter
    3. Sterilizing
    4. Fertility
  D. Planting and benching
    1. Depth
    2. Distance apart
    3. Support
    4. Humidity
    5. Soil moisture
  E. Development of plant structure
    1. Pinching
    2. Pruning
    3. Cutting of flowers
  F. Cropping and harvesting
    1. Season
    2. Demand
    3. Prices
    4. Timing
  G. Grading and bunching
    1. Stem length
    2. Condition of flower
    3. Insect injury
    4. Number in unit
    5. Roll or flat pack
  H. Shipping and marketing
    1. Type of container (box)
    2. Wrapping for temperature control
    3. Moisture control
    4. Transportation
    5. Wholesale commission market
    6. Direct to retailer
  I. General culture
    1. Watering
      a. Manually
      b. Injection
      c. Gates system
      d. Mist
    2. Soil nutrition
      a. Soil testing
      b. Dry fertilizer
      c. Liquid fertilizer
      d. Organic mulches
      e. Methods of application

- J. Insect and disease control
  - 1. Sanitation and disease prevention
  - 2. Insecticides
    - a. Spraying
    - b. Fumigation
- K. Resting, cutback and mulches
  - 1. Complete dormancy
    - a. Withhold water
    - b. Cutback
    - c. Remove all leaves
    - d. Time required
  - 2. Gradual cutback
    - a. Cut for harvest
    - b. Control soil moisture
    - c. Advantages
    - d. Time required
  - 3. Mulches
    - a. Manures
    - b. Peanut shells
    - c. Corncobs

- III. Chrysanthemum (*Chrysanthemum morifolium)* Cut Flower Production
  - A. Varieties and response groups
    - 1. Color
    - 2. Size
    - 3. Types
    - 4. Commercial values
    - 5. Bud initiation to bloom
    - 6. Timing of production
  - B. Young plant production
    - 1. Disease-free stock
    - 2. Cultured stock and cuttings
    - 3. Mother block
    - 4. Lights and temperatures
    - 5. Rooting media
    - 6. Mist
  - C. Planting and benching
    - 1. Distance apart (standard)
    - 2. Distance apart (pompoms)
    - 3. Marker or spacer
    - 4. Water
  - D. Timing and crop control
    - 1. Time pinching
      - a. Response group
      - b. Hard pinch
      - c. Soft pinch
      - d. Lights
      - e. Shade
      - f. Year-round production
    - 2. Bud selection
      - a. Crown bud
      - b. Terminal bud
    - 3. Control of number of stems and flowers per plant
      - a. Pruning
      - b. Disbranching
      - c. Disbudding
  - E. Harvesting, shipping, and marketing
    - 1. Maturity of flowers
      - a. Standard
      - b. Pompoms
      - c. Moisture
    - 2. Grading and bunching
      - a. Size
      - b. Quality of flowers
      - c. Number per unit
      - d. Weight grading
      - e. Automation
      - f. Conditioning
    - 3. Methods of packing and shipping
      - a. Corrugated box
      - b. Wooden hamper
      - c. Assorted colors and grades
      - d. Truck, rail, air freight
    - 4. Marketing
      - a. Wholesale commission market
      - b. Retail florist
      - c. Chain food and department stores
  - F. General culture
    - 1. Watering, fertilizing
      - a. Manual
      - b. Water boy
      - c. Gates system
      - d. Soil testing
      - e. Dry or liquid feeding
      - f. Methods
    - 2. Temperature control
      - a. Ventilation
      - b. Shading or greenhouse
      - c. Moisture content in greenhouse
      - d. Heat
    - 3. Insect and disease control
      - a. Spraying
      - b. Fumigation
      - c. Roguing
    - 4. Soil requirement
      - a. Type
      - b. Organic
      - c. Sterilizing
      - d. Testing
      - e. Additives

- IV. Carnation (*Dianthus caryophyllus*) Cut Flower Production
  - A. Popularity

        1. Introduction
        2. Types and varieties
        3. Wholesale and retail values
    B. Acquiring young plants
        1. Seed
        2. Cuttings
        3. Mother block
        4. Rooting media
        5. Misting system
        6. Shade
        7. Buy from specialist
    C. Soil preparation
        1. Testing of soil
        2. Addition of organic matter
        3. Sterilizing as steam and chemical
        4. Correct nutrient requirements
    D. Planting and benching
        1. Raised bench
        2. Ground bed
        3. Distance
        4. Marker
    E. Timing and cropping
        1. Season of planting
        2. Pinching
        3. 2-year plants
    F. Watering and fertilizing
        1. Manual
        2. Semiautomatic
        3. Water boy
        4. Dry or liquid fertilizer
        5. Proportioned
        6. Frequency
        7. Cooling
    G. Insect and disease control
        1. Spraying
        2. Fumigating
        3. Roguing
    H. Harvesting, grading, and conditioning
        1. Stage of maturity
        2. Stem length
        3. Flower size and quality
        4. Weight grading
        5. Refrigeration
    I. Shipping and marketing
        1. Packing
        2. Transportation
        3. Wholesale markets

V. Snapdragon (*Antirrhinum majus*) Cut Flower Production
    A. Introduction
    B. Selection of varieties
        1. Color
        2. Season of bloom
    C. Propagation
        1. Seed
        2. Cuttings
        3. Media
        4. Germination
    D. Soil preparation
        1. Soil test
        2. Addition of organic matter
        3. Sterilization
        4. Addition of fertilizer, if needed
        5. Rototill and level
    E. Planting and spacing
        1. Distance
        2. Single stem
        3. Pinched plants
        4. Direct seedlings
        5. Out of jiffy pots
        6. Season of the year
    F. General culture
        1. Support
            a. Wire and twine
            b. Wire-mesh gauge 12, 6″ x 6″
        2. Watering and fertilizing
            a. Manual
            b. Semiautomatic
            c. Dry or liquid feeding
            d. Proportioned
        3. Temperature control
            a. Ventilating
            b. Heating
            c. Shading
            d. Light
            e. Cooling
        4. Harvesting, grading, and conditioning
            a. Stage of flower development
            b. Stem length
            c. Flower spike length
            d. Water, flower preservative
            e. Refrigeration
    G. Shipping and marketing
        1. Packing
        2. Transportation
        3. Wholesale markets
    H. Insect and disease control
        1. Spraying
        2. Fumigation
        3. Sanitation
        4. Roguing

VI. Stocks (*Matthiola incana*) Cut Flower Production
    A. Introduction

    1. Varieties
    2. Single
    3. Double
  B. Propagation
    1. Seed
    2. Media
    3. Temperature
  C. Spacing, planting, and support
    1. Column or single
    2. Branching
    3. Transplants
    4. Jiffy pots
    5. Wire-mesh gauge 12, 6″ x 6″
  D. Harvesting, grading, and conditioning
    1. Stage of maturity
    2. Length of flower stem
    3. Length of flower spike
    4. Double flowering
    5. Single flowering
    6. Water, refrigeration
    7. Flower preservative
  E. General culture
    1. Water and fertilizer
      a. Manual
      b. Semiautomatic
      c. Gates system
      d. Dry and liquid feeding
      e. Methods and quantities
    2. Insect and disease control
      a. Spraying
      b. Fumigating
      c. Sanitation
      d. Roguing

VII. Sweet Pea (*Lathyrus odoratus*) Cut Flower Production
  A. Introduction
    1. Summer flowering
    2. Winter flowering
    3. Varieties
  B. Methods of propagation and germination
    1. Direct sowing
    2. Sowing in 2½″ pots
    3. Pregermination
    4. Seed treatment
  C. General culture
    1. Temperature
    2. Light
    3. Watering
  D. Soil preparation
    1. Soil testing
    2. Depth of preparation
    3. Sterilization
  E. Spacing and support
    1. Distance
    2. Height
    3. Materials
  F. Watering, fertilizing
    1. Method
    2. Depth
    3. Dry or liquid feeding
    4. Proportioned
  G. Harvesting, grading, and conditioning
    1. Stage of maturity
    2. Method of picking
    3. Bunching, grading
    4. Water, flower preservative
    5. Refrigeration
  H. Shipping and marketing
    1. Packaging
    2. Wholesale markets
  I. Insect and disease control
    1. Use of insecticides
      a. Spraying
      b. Fumigation
      c. Sanitation
    2. Safety precautions

VIII. Gardenia (*Gardenia grandiflora*) Cut Flower Production
  A. Introduction
    1. Values
    2. Varieties
  B. Propagation
  C. Soil preparation
    1. Soil testing
    2. Conditioning
    3. Sterilizing
  D. Planting and support
    1. Type of bed
    2. Tubs
    3. Metal galvanized stakes
  E. Pruning, disbudding, and harvesting
    1. Shaping
    2. Flower formation
    3. Stem length
  F. Tailoring, grading, and conditioning
    1. Size
    2. Quality
    3. Backing
    4. Packaging
    5. Refrigeration
  G. Shipping and marketing
    1. Transportation
      a. Truck
      b. Rail

- c. Air freight
- 2. Markets
  - a. Wholesale commission merchant
  - b. Retail florist
- H. General culture
  - 1. Watering
    - a. Manual
    - b. Semiautomatic
  - 2. Insect and disease control
    - a. Spraying
    - b. Fumigation
    - c. Roguing
  - 3. Temperature and humidity
    - a. Ventilation
    - b. Heating
    - c. Humidifying

- IX. Production of Potted Flowering Plants
  - A. Introduction. The general procedures for growing potted plants have much in common and the requirements are substantially the same for the following plants:
    - 1. Azalea *(Azalea hybrida)*
    - 2. African violet *(Saintapulia ionanha)*
    - 3. Chrysanthemum *(Chrysanthemum morifolium)*
    - 4. Cyclamen *(Cyclamen indicum)*
    - 5. Cineraria *(Senecio cruentus)*
    - 6. Calceolaria *(Calceolaria hybrids)*
    - 7. Hydrangea *(Hydrangea macrophylla)*
    - 8. Geranium *(Pelargonium domesticum)*
    - 9. Gloxinia *(Sinningia speciosa)*
    - 10. Kalanchoe *(Kalanchoe blossfeldiana)*
    - 11. Poinsettia *(Euphorbia pulcherrimma)*
    - 12. Bulbous plants
      - a. Tulip
      - b. Daffodil
      - c. Hyacinth
      - d. Iris
      - e. Lily
  - B. Structures and facilities
    - 1. Greenhouse size
    - 2. Cold frames
    - 3. Type of benches
  - C. Temperature and humidity
    - 1. Heating
    - 2. Ventilating
    - 3. Humidifying
    - 4. Cooling
  - D. Watering and fertilizing
    - 1. Manual
    - 2. Injection
    - 3. E-Flomatic-Chapin methods
    - 4. Mist
    - 5. Soil testing
    - 6. Methods of fertilizing
  - E. Soil and growth medias
    - 1. Soil types
    - 2. Organic matter
    - 3. Shredding and blending
    - 4. Methods of sterilizing
  - F. Pots and containers
    - 1. Clay
    - 2. Plastic
    - 3. Grades and sizes
  - G. Methods of propagation
    - 1. Seed
    - 2. Cuttings
    - 3. Division
  - H. Control of flowering and growth regulations
    - 1. Normal time required
    - 2. Temperatures
    - 3. Daylight, shade
    - 4. Chemicals
  - I. Insect and disease control
    - 1. Sanitation
    - 2. Spraying
    - 3. Fumigating
  - J. Shipping and transportation
    - 1. Wrapping
    - 2. Boxing, crating
    - 3. Truck, rail and air freight
  - K. Marketing
    - 1. Advertising
    - 2. Salesmen
    - 3. Direct to retailer

Recommended Laboratory Projects—96 hours

The suggested projects provide experience with roses, chrysanthemums, carnations, snapdragons, stocks, sweet peas, gardenias, flowering potted plants, green foliage, and house plants. Crops grown should be adapted to the region.

- I. Prepare soil for greenhouse crops (8 hours).

II. Sterilize soil for greenhouse crops (8 hours).

III. Make cuttings (10 hours).

IV. Sow seeds (5 hours).

V. Plant and pot greenhouse crops (15 hours).

VI. Pinch and support greenhouse crops (15 hours).

VII. Water and fertilize greenhouse crops (15 hours).

VIII. Control insects and diseases (5 hours).

IX. Harvest, grade, and bunch flowers (15 hours).

Texts and References

BALL. *The Ball Red Book.*

LAURIE, KIPLINGER, *and* NELSON. *Commercial Flower Forcing.*

LAURIE *and* REIS. *Floriculture Fundamentals and Practices.*

NELSON. *Flower and Plant Production in the Greenhouse.*

POST. *Florist Crop Production.*

Trade Publications:
  Florist and Nursery Exchange.
  Florists' Review.
  Growers' Talks.
  New York State Flower Growers' Bulletin.

Instructional Aids

Flowers
Kodachrome slides

HERBACEOUS PLANTS I

Hours Required

Class, 1; Laboratory, 2

Course Description

An introductory study of herbaceous plants used for garden and landscape display, with emphasis on various operations of horticultural business such as the seed trade, garden design, perennial nursery and bedding plant production, and garden center operation. Plant materials and plants studied include garden annuals, biennials, perennials, bulbs, ground covers, vines, ferns, wildflowers, aquatic plants, subshrubs and roses.

Class topics include classification, production, culture, and uses of materials as well as consideration of design principles.

A complete study of herbaceous plants should be conducted during the growing season if possible. Seasonal timeliness is an important consideration in teaching a course on herbaceous plants. For courses which must be scheduled at off season times, the maximum use of visual aids is necessary. When possible, a summer semester of study should be provided for seasonal coverage of the subject. Classroom instruction should precede laboratory study.

Major Divisions

	Class Hours
I. Value and Limitations of Herbaceous Plants	1
II. Anatomy of the Flower	1
III. Classification of Flowering Plants	1
IV. Common Garden Families—Identifying Characteristics	2
V. Growth Forms of Herbaceous Plants	1
VI. Propagation	2
VII. Seedage	1
VIII. Spring Bulbs	2
IX. Biennials	2
X. Ecology of Wild Flowers	1
XI. Phenology (A Record of Appearances)	1
XII. Garden Roses	1
Total	16

Units of Instruction

I. Value and Limitations of Herbaceous Plants
  A. The herbaceous growth habit of woody plants
  B. Natural advantages—range of adaptation
    1. Alpine or Arctic
    2. Desert
    3. Seaside
    4. Meadow
    5. Woodland
  C. Limitations in the landscape
  D. Uses in the landscape

II. Anatomy of the Flower
  A. Morphological concept—a specialized reproductive brand
    1. Peduncle
    2. Pedicel
    3. Receptacle
    4. Perianth
    5. Androecium
    6. Gynoecium
  B. Entomophilous or anemophilous
  C. Zygomorphic or actinomorphic
  D. Fusion of parts
  E. Dioecious or monoecious
  F. Epigynous or hypogous

III. Classification of Flowering Plants
  A. Vegetable kingdom
    1. Division
    2. Subdivision
      a. Gymospermae
      b. Angiospermae
    3. Class
      a. Monocotyledoneae
      b. Dicotyledoneae
    4. Order
    5. Family
    6. Genus
    7. Species (concept)
    8. Variety (cultivar)
  B. The binomial system of classification
  C. Types of inflorescence
    1. Solitary
    2. Multiple
      a. Raceme
      b. Spike
      c. Catkin
      d. Umbel
      e. Corymb
      f. Spadix
      g. Head

- 3. Compound
  - a. Panicle
  - b. Compound spike
  - c. Compound umbel

IV. Common Garden Families—Identifying Characteristics

- A. Common families
  - 1. Arum
  - 2. Lily
  - 3. Amaryllis
  - 4. Iris
  - 5. Orchid
  - 6. Mustard
  - 7. Buttercup
  - 8. Viola
  - 9. Primrose
  - 10. Evening primrose
  - 11. Rose
  - 12. Daisy
  - 13. Sweet pea
  - 14. Nightshade
- B. Floral diagrams and formulae

V. Growth Forms of Herbaceous Plants

- A. Below ground
  - 1. Bulb
  - 2. Corm and cormels
  - 3. Tuber
  - 4. Tuberous root
  - 5. Pip
  - 6. Rhizoma
- B. Surface
  - 1. Stolon
  - 2. Runner
  - 3. "Root stock"
  - 4. Crown
- C. Aerial
  - 1. Bulbils
  - 2. Ramies

VI. Propagation

- A. Divisions
- B. Offsets
- C. Cuttings—soft and hard
- D. Layer

VII. Seedage

- A. Seed size
- B. Media
- C. Germination
  - 1. Steps
  - 2. Conditions for
- D. Methods of sowing
  - 1. Outdoor
    - a. Broadcast
    - b. Drills
    - c. Hills
  - 2. Indoor
    - a. Flats
    - b. Pots
    - c. Market packs
    - d. Other
- E. Transplanting
  - 1. Pricking off—dibbling
  - 2. Hardening off
  - 3. Planting out

VIII. Spring Bulbs

- A. Narcissus
  - 1. Horticultural classification
  - 2. Uses
    - a. Forcing
    - b. Naturalizing
  - 3. Culture
    - a. Grades of bulbs
    - b. Planting
    - c. Separation
  - 4. Troubles—remedies
    - a. Nematode
    - b. Basal rot
    - c. Virus
    - d. Bulb fly
- B. Tulip
  - 1. History
  - 2. Horticultural classification
  - 3. Uses
    - a. Forced
    - b. Garden
  - 4. Culture
  - 5. Troubles—remedies
    - a. Virus
    - b. Diseases
- C. Other spring bulbs
  - 1. Crocus
  - 2. Chionodoxa
  - 3. Eremurus
  - 4. Fritillaria
  - 5. Muscari
  - 6. Hyacinth
  - 7. Scilias
  - 8. Iris
- D. Summer bulbs
  - 1. Gladiola
  - 2. Montbritia
  - 3. Tuberose
  - 4. Alliums

- E. Tubers
    - 1. Dahlia
    - 2. Tuberous begonia

IX. Biennials

- A. Uses
- B. Kinds
    - 1. Viola
    - 2. Bellis
    - 3. Myosotis
    - 4. Campanula
    - 5. Cheiranthus
    - 6. Lunaris
    - 7. Hesperis
    - 8. Digitalis
    - 9. Althaes
    - 10. Verbascum
- C. Culture

X. Ecology of Wild Flowers

- A. Pond association
- B. Marsh-swamp association
- C. Bog association
- D. Meadow association
- E. Forest association
    - 1. Maple—hemlock
    - 2. Oak—hickory
    - 3. Evergreen (coniferous)
- F. Seaside
    - 1. Shore
    - 2. Dunes
    - 3. Salt-marsh
- G. Glacial Relicts

XI. Phenology (A Record of Appearances)

- A. Continued study of first appearance
- B. Plant characteristics for record
    - 1. Plant growth habit
        - a. Annual
        - b. Biennial
        - c. Perennial
        - d. Bulb
        - e. Herb
        - f. Subshrub
        - g. Shrub
        - h. Grass
    - 2. Plant form
        - a. Mat
        - b. Upright
        - c. Rounded
        - d. Spire
        - e. Lance leaved
    - 3. Other data
        - a. Color
        - b. Height
        - c. Dates of bloom—span of bloom
        - d. Special uses

XII. Garden Roses

- A. History and classification
- B. Culture
- C. Uses
- D. Rose garden design and shade gardening

Recommended Laboratory Projects—32 hours

Prepare a laboratory notebook complete with labeled drawings for each of the following:

- I. Anatomy of flowers and their classifications (6 hours).
- II. Study the anatomy of the tulip, lily and iris flowers (2 hours).
- III. Study the anatomy of the stock, snapdragon, rose and pea flowers (2 hours).
- IV. Use the dichotomous key to identify plant families (2 hours).
- V. Study the types of inflorescences (2 hours).
- VI. Study the bulbs and tuberous plant forms (2 hours).
- VII. Propagate by cuttage (2 hours).
- VIII. Propagate by seedage (2 hours).
- IX. Study outdoor herbaceous plant materials (12 hours).

Texts and References

BUSH-BROWN. *America's Garden Book.*

Instructional Aids

Botanical models
Charts of floral anatomy
Designs and plans for plantings
Greenhouses and gardens
Herbaceous materials and flowers
Preserved herbaceous materials
Slides and pictures

HERBACEOUS PLANTS II

Hours Required

Class, 1; Laboratory, 3

Course Description

A continuation of Herbaceous Plants I.

Major Divisions

	Class Hours
I. Annuals—A Study List as Guide	3
II. Summer Perennials	1
III. September Perennials	1
IV. Chrysanthemums	2
V. Principles of Planting Design	1
VI. Color in Garden Design	1
VII. Succession of Bloom	1
VIII. Design of Mixed Border	1
IX. Rose Garden Design	1
X. Rock Garden Design	1
XI. Gardening With Herbs	1
XII. Aquatic Gardens	1
XIII. Winter Effects With Evergreen Materials	1
Total	16

Units of Instruction

- I. Annuals—A Study List as Guide
  - A. Geographical origin
  - B. Cool season (hardy) annuals
  - C. Long season annuals
  - D. Late season annuals
  - E. The big five
    - 1. Petunia
    - 2. Marigold
    - 3. Zinnia
    - 4. Snapdragon
    - 5. Aster
  - F. Annuals for shade
    - 1. Begonia
    - 2. Lobelia
    - 3. Impatiens
    - 4. Torenia
    - 5. Coleus
  - G. Cutting garden annuals
  - H. Fragrant annuals
  - I. Merchandising annuals
- II. Summer Perennials
  - A. Daylilies
  - B. Phlox
  - C. Rudbeckia
  - D. Others
- III. September Perennials
  - A. Aster
  - B. Anemone
  - C. Leadwort
  - D. Eupatorium
- IV. Chrysanthemums
  - A. History
  - B. Classification
  - C. Uses
    - 1. Commercial
    - 2. Garden display
    - 3. Exhibition
    - 4. Cut flowers
  - D. Photoperiodism
    - 1. Black cloth
    - 2. Artificial lighting
  - E. Standards and disbuds
    - 1. Commercial production schedules
    - 2. Control of blooming time
  - F. Pot growing
  - G. Growing for show
  - H. Troubles and solutions
- V. Principles of Planting Design
  - A. Background—unity
  - B. Color harmony
  - C. Composition
    - 1. Height
    - 2. Size
    - 3. Time of bloom
  - D. Drift planting
    - 1. Proportions of drifts
    - 2. Contrasts
    - 3. Rhythms
- VI. Color in Garden Design
  - A. Vocabulary of color
  - B. The nature of color—a sensation
    - 1. Light, spectral hues
    - 2. Pigments and paints
    - 3. Plant pigments
  - C. Use and the psychology of color
    - 1. Xanthic—advancing hues
    - 2. Cyanic—retreating hues
  - D. Reasons for poor color results
    - 1. Discordant hues
    - 2. Poor background
    - 3. Lack of dominance
    - 4. Poor visibility
  - E. Standards of success with garden color
    - 1. Color appropriate to use

    2. Pleasing to the beholder
    3. Of long duration
VII. Succession of Bloom
  A. Organization of areas in garden for seasonal masses
  B. Dominant color themes for each succeeding period
    1. Spring
    2. Early summer
    3. Midsummer
    4. Fall
  C. Selection of materials for pleasing combinations
    1. Height
    2. Plant form
    3. Color
    4. Texture
  D. Succession of bloom
    1. Replacement planting
    2. Interplanting
    3. Overplanting
    4. Planting in juxtaposition
    5. Selection of varieties for extended bloom
    6. Shift of attention to adjacent areas
VIII. Design of Mixed Border
  A. Background or enclosure
  B. Bed dimensions proportionate to total area and to height of background
  C. Organization in depth
    1. Edge
    2. Foreground
    3. Iris or lance leaved strip
    4. Midsummer strip
    5. Background strip (rear)
  D. Design of background drifts
    1. Consider points of view
    2. Viewing distances
    3. Direction of flow of interest
    4. Dominant masses
    5. Contrasts
IX. Rose Garden Design
  A. Backgrounds
  B. Bed size and spacing
  C. Walk surfacing
  D. Ease of maintenance
  E. Choice of roses
X. Rock Garden Design
  A. "Alpine" gardens
  B. Appropriate siting
    1. Varied topography necessary
    2. Background necessary
  C. Scale—a miniature landscape
  D. Circulation—paths for easy maintenance
  E. Rock formations
    1. Igneous
    2. Sedimentary
    3. Moraine
  F. Water courses
XI. Gardening With Herbs
  A. Kind
    1. Culinary
    2. Medicinal
    3. Aromatic
  B. Plants with winter foliage effects
XII. Aquatic Gardens
  A. Types
    1. Pond
    2. Marsh
    3. Bog
    4. Stream
  B. Construction
  C. Plant materials
    1. Trees and shrubs—for wet soil
    2. Pondside herbs
    3. Aquatic
      a. Lilies, tropical
      b. Lotus and hardy lilies
      c. Other
XIII. Winter Effects With Evergreen Materials
  A. Value in close by areas
    1. Patios
    2. Terraces
    3. Rockeries
    4. Herbaceous borders
  B. Texture study factors
    1. Size of leaf
    2. Shape of leaf
    3. Arrangement of leaves
    4. Spacing of leaves and twigs
    5. Surface quality
    6. Plant mass
  C. Plant materials
    1. Creeping ground covers
    2. Mat forming plants
    3. Cushion plants
    4. Subshrubs

Recommended Laboratory Projects—48 hours

A notebook should be kept reflecting the following activities.

1. Study field plantings of annuals (9 hours).
II. Study field plantings of perennials (9 hours).
III. Participate in a flower show (3 hours).
IV. Study texture (3 hours).
V. Study color (3 hours).
VI. Design a garden of annuals (3 hours).
VII. Design a garden of chrysanthemums (3 hours).
VIII. Design a mixed border to show continuous bloom from spring to fall (15 hours).

Texts and References

ORTLOFF *and* RAYMORE. *Color and Design.*
TAYLOR. *Guide to Garden Flowers.*

Instructional Aids

Same as Herbaceous Plants I

HORTICULTURAL APPLICATIONS

Hours Required

Class, 1; Laboratory, 3

Course Description

This course is designed to further develop skills and understanding of horticultural processes and operations which are approached abstractly in other courses. Ideally this subject is best taught in the growing season because the course emphasizes field practices as a necessary adjunct to classroom theory. The experience gained develops familiarity with and respect for soils, plants, and tools. Moreover, field performances develop capacities for work and the ability to work harmoniously with others. A well-rounded experience in a diversified work situation will prove and clarify a young student's interests in the horticultural field. There is carryover of this knowledge to all horticultural activities.

Each laboratory period is preceded by an orientation lecture and a demonstration of the topic for the week. Where possible, each class section performs the operation in a campus situation and students are observed, advised, and rated. At the close of the period a critique is held.

Where school facilities and equipment are not adequate, other approaches should be explored, such as:

A. Cooperative work-experience programs
B. Laboratory use of park, nursery, cemetery and golf course facilities

Major Divisions

	Class Hours
I. Orientation	1
II. Equipment	1
III. Lawn Management	2
IV. Weeds and Weed Controls	2
V. Drainage and Soil Aeration	2
VI. Hedges	2
VII. Pruning and Training	2
VIII. Garden Management	2
IX. Soil Management	2
Total	16

Units of Instruction

I. Orientation
  A. Subject coverage—all aspects of garden operation outlined
  B. Grading
    1. Periodic quizzes on lecture material, 20 percent
    2. Field work, 80 percent: assessed on basis of application, attitude, production, and improvement. A student should qualify on the following points:
      a. Perform work skillfully
      b. Follow directions
      c. Work without surveillance
      d. Solve problems intelligently
      e. Learn from mistakes
      f. Receive criticism well
      g. Maintain a steady output
      h. Follow through on projects
      i. Cooperate with fellow students
      j. Accept unforeseen difficulties with grace
      k. Assume responsibility when assigned
      l. Work well on all projects whether or not to his liking
  C. Final evaluation—instructors will consider:
    1. Has student improved during the course?
    2. Has student worked to his true capacity and ability?
    3. If the opportunity arose, would he hire the candidate?

II. Equipment
  A. Garden tools—display and describe
    1. Basic tools
      a. Spade
      b. Shovel (round point)
      c. Shovel (square)
      d. Spading fork
      e. Scuffle hoe
      f. Hand weeders
      g. Border shears
      h. Orchard saw
      i. Hand shears
      j. Knives (pruning, budding and grafting)
      k. Trowel
      l. Iron rake
      m. Leaf rake
    2. Other types
      a. Axe
      b. Brush hook
      c. Dibble
      d. Draw hoe

- e. Edger (half moon)
- f. Edger (wheel types)
- g. Grass shears
- h. Grass whip
- i. Grub hoe
- j. Grub axe, mattock
- k. Hay fork
- l. Manure fork
- m. Pruning saw (tree)
- n. Pick (pick mattock)
- o. Pole saw
- p. Pole pruner
- q. Rake (wooden)
- r. Scoop
- s. Sod lifter
- t. Sickle
- u. Scythe
- v. Trowel

3. Types of general hand tools
    - a. Saws
    - b. Pliers
    - c. Hammers
    - d. Screw drivers
    - e. Wrenches
    - f. Drills
    - g. Other
4. Care of tools
    - a. Sharpening (file, grinding wheel, grindstone, and carborundum whetstone)
    - b. Repair and replacement
    - c. Daily care; clean off soil and hang up
    - d. Winter storage
        - (1) Remove dirt and rust
        - (2) Oil or grease metal surfaces
        - (3) Treat wood handles 50/50 raw linseed oil and turpentine

B. Lawn mowers

1. Hand mower
    - a. Nomenclature
        - (1) Reel
        - (2) Bed knife
        - (3) Drive wheel and gears
        - (4) Rollers
    - b. Adjustments
        - (1) Reel cones
        - (2) Bed knife screws
        - (3) Roller brackets
    - c. Sharpening
        - (1) Machine sharpening
        - (2) Reverse reel with emery compound
    - d. Lubrication
2. Power mower
    - a. Relative merits of reel vs. rotary
    - b. Relative merits of 2 cycle, 4 cycle, and electric motor
    - c. Nomenclature of each type
    - d. Adjustments
    - e. Maintenance
    - f. Mowing techniques
    - g. Mowing hazards
    - h. Season height of cut
3. Lawn edging
    - a. Margins
        - (1) Between turf and paving
        - (2) Between turf and planting areas
        - (3) Between turf and vertical surfaces
    - b. Purpose: to define areas and line effects
    - c. Materials used in edge
        - (1) Landscape steel edging
        - (2) Wood
        - (3) Plastic
        - (4) Corrugated strip material
        - (5) Stone, brick and slate
    - d. Edging tools
        - (1) Spade
        - (2) Halfmoon edger
        - (3) Scuffle hoe
        - (4) Rotary edger
        - (5) Edging shears
        - (6) Edging mowers
        - (7) Power edgers

III. Lawn Management

A. Spring operations

1. Rolling
2. Renovation
3. Fertilization
4. Grub proofing
5. Weed control
6. Sodding

B. Summer operations

1. Mowing; height and frequency
2. Irrigation
3. Insect control
4. Fungus control

C. Fall operations

1. Preparations for seeding
    - a. Tillage

        - b. Grading
        - c. Grubproofing
        - d. Fertilization and lime
        - e. Aero cyanamid treatment
    - 2. Seeding methods
    - 3. Renovation and overseeding

IV. Weeds and Weed Controls
- A. Kinds of weeds
    - 1. Annual herbs
    - 2. Biennial herbs
    - 3. Perennial herbs
    - 4. Ligneous plants
    - 5. Grasses
    - 6. Other (mosses, algae and lichens)
- B. Means of perpetuation
    - 1. Seed
    - 2. Offsets
    - 3. Rhizomes
- C. Manual controls
    - 1. Cultivation
    - 2. Roguing
    - 3. Mulching
- D. Chemical controls
    - 1. Soil sterilization
    - 2. Soil fumigation
    - 3. Nonselective killers
        - a. Hydrocarbon
        - b. Fire
        - c. Systemics
        - d. Caustics
    - 4. Selective weed killers
        - a. For woody plants
        - b. For turf
        - c. Other
- E. Application of weed controls
    - 1. Precautionary measures
    - 2. Fumigants
    - 3. Liquid material
    - 4. Granular material
    - 5. Estimating dosage of weedicides

V. Drainage and Soil Aeration
- A. Control of surface drainage
    - 1. Soil porosity
    - 2. Degree of slope
    - 3. Contour grading
    - 4. Ditching
        - a. Turf gutters
        - b. Asphalt and other gutters
    - 5. Spillways
- B. Control of subsurface drainage
    - 1. Soil texture
    - 2. Soil condition (structure)
        - a. Flocculants
        - b. Resins
    - 3. Water tables
    - 4. Artificial drains
        - a. "Moles"
        - b. Ceramic tile
        - c. Perforated pipe
            - (1) Concrete
            - (2) Composition
        - d. Other
- C. Problems of drainage with walls
    - 1. Retaining; weep holes
    - 2. Foundation; waterproofing

VI. Hedges
- A. Purposes
    - 1. Screen
    - 2. Windbreak
    - 3. Background or enclosure
    - 4. Design reasons (topiary)
- B. Characteristics of good hedge material
    - 1. Dense growing
    - 2. Long lived
    - 3. Shade tolerant
    - 4. Moderate growers
    - 5. Evergreen
    - 6. Drough resistant
    - 7. Good color and texture
    - 8. Pest resistant
- C. Training hedge material
    - 1. Shape
        - a. Rounded (poor)
        - b. Straightsided (good)
        - c. Overhanging (poor)
        - d. Pyramidal (good)
    - 2. Height; no higher than to serve their purpose
    - 3. Shearing; twice or more in a season
        - a. Sickle
        - b. Hedge shears
        - c. Electric hedge trimmer
    - 4. Shaping; natural effect by selective pruning with hand shears or knife
    - 5. Guide lines and levels
    - 6. Topiary work

VII. Pruning and Training
- A. Definitions
    - 1. Pruning: the systemic removal of plant parts with a special purpose in mind
    - 2. Training; the control of plant growth and form through pruning techniques

to fit the plant to its particular function

- B. Reasons for pruning
  - 1. Production
  - 2. Safety
  - 3. Health
  - 4. Appearance
  - 5. Clearance
  - 6. Rejuvenation
- C. Types of pruning
  - 1. Fruit pruning
    - a. Aim: to encourage sustained yield of high quality
    - b. Growth cycles of fruit plots
      - (1) Bramble fruits
      - (2) Blueberry
      - (3) Apples and pears (pomaceous)
      - (4) Peaches and plums (drupaceous)
      - (5) Grapes
      - (6) Citrus fruits
  - 2. Shade tree pruning
    - a. Aims: multipurpose, health, safety, and appearance
    - b. Industry pruning standards
  - 3. Topiary pruning (the shaping of plants by shearing techniques)
  - 4. Timber management to produce high grade saw timber, free of knots and defects
  - 5. Landscape pruning to maintain and control the size, shape and bloom of ornamental plants by selective pruning techniques
- D. Pruning tools
  - 1. Pruning knife
  - 2. Berry hook—"secateur"
  - 3. Hand pruners
  - 4. Lopping shears
  - 5. Orchard saw
  - 6. Tree surgeon's saw
  - 7. Pole saw
  - 8. Pole pruner—"averruncator"
- E. Timing and frequency of pruning

VIII. Garden Management

- A. Standards of appearance
  - 1. Walks
    - a. Clean swept
    - b. Weed free
    - c. Properly alined
    - d. Sharply edged
  - 2. Hedges and backgrounds
    - a. Proportionate to the area involved
    - b. Well foliated at base
    - c. Perfectly sheared
    - d. Good color and vigor
  - 3. Lawns
    - a. Weed free
    - b. Dense growth
    - c. Good color
  - 4. Herbaceous borders
    - a. Generous plant masses
    - b. No vacant spots
    - c. Weed free
    - d. Pleasing colors
    - e. Some bloom at all times
    - f. Spent flowers removed
  - 5. Shrubs
    - a. Free of old growth
    - b. Not overgrown
- B. Seasonal routine
  - 1. Spring
    - a. Cleanup and renovation
    - b. Separation of fall-blooming perennials
    - c. Fertilization
    - d. Cultivation of beds
    - e. Setting out of biennials and annuals
  - 2. Summer
    - a. Pinching and staking perennials
    - b. Spray for pest control
    - c. Irrigate
    - d. Control weeds
    - e. Trim hedges
  - 3. Fall
    - a. Plan for and plant bulbs
    - b. Winterize tender materials
    - c. Feed trees, shrubs, and lawns
    - d. Compost garden refuse and leaves

IX. Soil Management

- A. Preparation of soil
- B. Maintenance of soil organic matter
  - 1. Organic matter defined as "plant and animal remains in various stages of decomposition"
  - 2. Leaf mold
  - 3. Humus
  - 4. Peat
- C. Benefits of organic matter in soil
  - 1. Soil condition
    - a. Structure
    - b. Tilth
    - c. Water relationships

    2. Soil temperature
    3. Fertility
- D. Composting
    1. Purpose
    2. Materials for
    3. Role of micro-organisms
    4. Conditions for decomposition
    5. Types of compost piles
    6. Formulae for additives
- E. Soil preparation
    1. Improved tilth
    2. Double digging

Recommended Laboratory Projects—48 hours

I. Examine horticultural hand tools, their construction, care and repair, and practice safe usage (6 hours).

II. Examine weeds common to the region and control them (6 hours).

III. Fertilize at least one lawn (3 hours).

IV. Study the different power equipment and its safe use and adjustment (3 hours).

V. Care for different lawn areas (9 hours).

VI. Prune trees and shrubs (6 hours).

VII. Shear a hedge (3 hours).

VIII. Care for assigned garden or gardens (6 hours).

IX. Practice good soil management (6 hours).

Texts and References

BUSH-BROWN. *America's Garden Book.*
CHRISTOPHER. *Pruning Manual.*
DONAHUE. *Our Soils and Their Management.*
JANICK. *Horticultural Science.*
ROCKWELL. *Complete Guide to Sucessful Gardening.*

Instructional Aids

Plans and illustrations of operations

HORTICULTURAL AND TURFGRASS EQUIPMENT

Hours Required

Class, 2; Laboratory, 3

Course Description

This course acquaints students with various types of mechanized equipment and teaches them the principles of operating and using power equipment in horticultural and turf operations.

Knowledge of mechanized equipment necessary for the management of horticultural and turf areas is emphasized as an important requirement for specialists in all phases of ornamental horticulture, especially turf management. Types of mobile and portable power units, their selection, operation, maintenance and "tune-up" also are emphasized. Theories and principles of operation of basic engines, pumps, transmissions and electric motors are stressed in relation to safety and the practical and economic management of equipment.

Following instruction in the general theories and principles of operation of power units, students are taught the specific uses of various types of tractors, mowers, sprayers, soil tillers, aerators, thatching units, and trimmers. Lectures by representatives of various equipment dealers supplement formal instruction. Field trips to local dealers, contractors, golf courses, and park departments afford the students opportunities for direct observation of equipment selected and operated under various conditions.

Major Divisions

	Class Hours
I. Introduction	1
II. Operation "Safety"	2
III. Types of Tractors	3
IV. Component Systems	7
V. Internal Combustion Engine Cycles and Principles	5
VI. Graders and Tillers	3
VII. Mowing Units	4
VIII. Turf Renovators	3
IX. Sprayers and Miscellaneous Units	4
Total	32

Units of Instruction

I. Introduction
  A. Purchasing considerations of equipment
    1. Efficiency
    2. Ease of operation
    3. Need
    4. Cost
      a. Initial
      b. Operation
  B. Safety

II. Operation "Safety"
  A. Mounting and dismounting
  B. Starting and stopping
  C. Refueling safely
  D. Controlling speed of travel
  E. Turning safely
  F. Use of power units
  G. Use of safety shields
  H. Stop the engine for servicing
  I. Proper lubrication and checkout

III. Types of Tractors
  A. Wheel type
    1. Tricycle
    2. Standard four-wheel
  B. Orchard
    1. Four-wheel low
    2. Shielded
  C. Garden
    1. Two-wheel aircooled
      a. One cylinder
      b. Two cylinders
    2. Four-wheeled watercooled
  D. Crawler or track type

IV. Component Systems
  A. Tractor components
    1. Power unit
      a. Engine
      b. All accessories
    2. Power train
    3. Chassis
  B. Power unit
    1. Stationary parts which support moving parts
    2. Power chain to receive, exert, and transmit motive force
    3. Valve system to time and operate valves
    4. Auxiliary parts to cool, lubricate, and provide ignition and fuel
    5. Stationary parts
      a. Cylinder block
      b. Cylinder head

- c. Crankcase
- d. Oil pan
- 6. Power chain
  - a. Piston
  - b. Piston pins
  - c. Piston rings
  - d. Connecting rods and bearings
  - e. Crankshaft and bearings
  - f. Flywheel
- 7. Valve systems
  - a. Valves—intake and exhaust
  - b. Camshaft
  - c. Valve tappets
  - d. Push rod
  - e. Rocker arm
- 8. Fuel system
  - a. Fuel tank
  - b. Shut-off valve
  - c. Sediment bowl
  - d. Fuel line
  - e. Fuel pump
  - f. Carburetor
  - g. Manifold
- 9. Ignition system
  - a. Battery or magnets
  - b. Coil
  - c. Spark plugs
  - d. Switch
  - e. Connecting wires
  - f. Timing mechanisms—distributor, points and condenser
- 10. Cooling system
  - a. Radiator
  - b. Thermostat
  - c. Fan
  - d. Pump
  - e. Water jacket
  - f. Hoses and connections
- 11. Lubrication system (oil)
  - a. Pan
  - b. Pump
  - c. Lines
  - d. Gauge
  - e. Filter
  - f. Grease and oil fittings
- 12. Governing system
  - a. Weights and springs
  - b. Detentarm or finger (hit-and-miss system only)

- C. Power train
  - 1. Clutch
  - 2. Differential
  - 3. Transmission
  - 4. Final drive mechanism
  - 5. Belt pully
  - 6. Power take-off
  - 7. Power lift control
- D. Chassis
  - 1. Frame
  - 2. Steering mechanism
  - 3. Brakes
  - 4. Wheels and tires

V. Internal Combustion Engine Cycles and Principles

- A. Types of engines
  - 1. Four-stroke cycle
  - 2. Two-stroke cycle
  - 3. Diesel cycle
- B. Essentials for engine operation—proper sequence
  - 1. Fuel in cylinder
  - 2. Sufficient air to furnish oxygen for combustion
  - 3. Mixture of gas vapor and air
  - 4. Compression of mixture
  - 5. Ignition of fuel
  - 6. Removal of combustion products
- C. Four-stroke cycle operation
  - 1. Definition
  - 2. Stroke
  - 3. Cycle of events
  - 4. Four-stroke cycle
- D. Two-stroke cycle characteristics
  - 1. Distinguishing mechanical characteristics
    - a. Crankcase enclosed and airtight
    - b. Ports in side of cylinder open and close by piston movement; take place of valves
    - c. Valve-operating mechanism unnecessary
    - d. Fuel mixture usually passes through crankcase on way to cylinder
    - e. Cylinder usually vertical
  - 2. Advantages of two cycle
    - a. Lighter in weight per horsepower
    - b. Simpler in construction
    - c. Greater frequency of work strokes or power impulses
    - d. Usually operates in either direction
  - 3. Some disadvantages of two cycle
    - a. Fuel mixture controlled with difficulty
    - b. Inefficient in fuel consumption

            - c. Unsatisfactory operation under fluctuating loads
            - d. Speed and corresponding power not readily controlled
            - e. Cooling and lubrication difficult
    - E. General definitions
        - 1. Firing interval
            - a. Four-stroke cycle engine
            - b. One-cylinder, four-stroke cycle engine
            - c. One-cylinder, two-stroke cycle engine
        - 2. Compression ratio
        - 3. Combustion or clearance space
        - 4. Total cylinder volume
        - 5. Piston displacement
        - 6. Bore
        - 7. Stroke
        - 8. Piston chamber

- VI. Graders and tillers
    - A. Grading units
        - 1. Blade types
        - 2. Stone rakes
        - 3. Cultipacker and various combination units
    - B. Tillers (cultivators)
        - 1. Disc harrows
        - 2. Spring tooth harrows
        - 3. Meeker harrow
        - 4. Rotary hoe type
    - C. Hitches for tractor-drawn units
    - D. Construction features
    - E. Service and maintenance
    - F. Field adjustments
    - G. Recommended uses

- VII. Mowing units
    - A. Types of cutting action units
        - 1. Scissors action—reel-type
        - 2. Impact action
            - a. Rotary
            - b. Chain link (hammer knife)
    - B. Power supply
        - 1. Self-propelled
        - 2. Tractor-drawn
    - C. Construction features
    - D. Adjustments
    - E. Maintenance
        - 1. Lubrication
        - 2. Sharpening
        - 3. Replacing cutting edges or units
        - 4. Miscellaneous
    - F. Recommended uses

- VIII. Turf Renovators
    - A. Aerators
        - 1. Core removal
        - 2. Spiker
        - 3. Disc
    - B. Thatching removal units
        - 1. Cutting edges
        - 2. Operational principles
    - C. Power supply
        - 1. Self-propelled
        - 2. Tractor-drawn
    - D. Construction features
    - E. Adjustments
    - F. Maintenance
    - G. Operational instruction

- IX. Sprayers and Miscellaneous Units
    - A. Sprayers
        - 1. Types and uses
            - a. Trees and shrubs
            - b. Turf
        - 2. Tanks
        - 3. Power requirement
        - 4. Pressure requirement
        - 5. Maintenance and adjustments
        - 6. Operational procedures
    - B. Fertilizer and seed spreaders
        - 1. Gravity feed
        - 2. Centrifugal type
    - C. Sod cutters
    - D. Grass, hedge and shrub trimmers; pruners
    - E. Edgers
    - F. Chain saws
    - G. Soil shredders

Recommended Laboratory Projects—48 hours

- I. Demonstrate and practice safety procedures outlined in Unit II (3 hours).
- II. Practice operational procedures of various tractor types (9 hours).
- III. Develop exercises with the component systems (9 hours).
- IV. Develop and demonstrate exercises with internal combustion engines (6 hours).
- V. Provide exercise with tillers and/or graders (3 hours).
- VI. Provide exercise handling and adjusting mowing units (6 hours).
- VII. Provide exercise handling turf renovators (3 hours).

VIII. Provide exercise handling sprayers (3 hours).

IX. Visit commercial and municipal sites to view equipment operations (6 hours).

Texts and References

American Oil Company. *Engineering Bulletin Farm Tractors.*

Crouse. *Automotive Electrical Equipment.*

———. *Automotive Mechanics.*

Gulf Oil Company. *Gulf Farm Tractor Guide.*

Individual Manufacturers. *Equipment Operator and Maintenance.*

———. *Instruction Manuals.*

Jones. *Farm Gas Engines and Tractors.*

Instructional Aids

General Motors Corporation, 1775 Broadway, New York, N.Y. 10019.

The ABC of Internal Combustion Engines. 18 minutes, 16 mm, color, sound.

ABC of Diesel Engine. 20 minutes, 16 mm, color, sound.

New York State College of Agriculture Film Library, Ithaca, N.Y. 14850.

Farm Tractor Safety, A Family Affair. 18 minutes, 16 mm, color, sound.

HOUSE AND CONSERVATORY PLANTS I

Hours Required

Class, 2; Laboratory, 2

Course Description

This course familiarizes the student with the many native and tropical plants used as house plants and with exotic plants cultivated in botanical gardens and conservatories. Indentification, propagation, and cultural requirements of these plants and construction of dish gardens and terrariums also are studied.

Major Divisions

	Class Hours
I. Introduction	2
II. The Study of Indoor Plants: Nomenclature, Ecology, Cultural Requirements, Propagation, and Overall Care of Approximately 200 Plants	18
III. Plant Growing Structures	2
IV. General Environment for Maximum Plant Growth	2
V. Containers: Pots and Planters	1
VI. Watering Methods and Needs	1
VII. Insect and Disease Control: Care of Plants in the Home	2
VIII. The Terrarium	1
IX. The Dish Garden	1
X. Overall Care of House Plants	2
Total	32

Units of Instruction

I. Introduction
  A. The value of knowing indoor plant material
    1. Interior decoration
    2. Selection and uses of plants
  B. Business opportunities
    1. Self-employment
    2. Botanical gardens and parks
    3. Positions with florists specializing in indoor landscaping

II. The Study of Indoor Plants: Nomenclature, Ecology, Cultural Requirements, Propagation, and Overall Care of Approximately 200 Plants
  A. Standardized plant names
    1. Plant families
    2. Genera
    3. Species
    4. Varieties
  B. Identification
    1. The plant
    2. A branch
    3. Leaves and/or flowers
  C. Environment
    1. Temperature
    2. Humidity
    3. Light
  D. Growth media
    1. Soil
    2. Peat moss
    3. Perlite and vermiculite
    4. Sand
  E. Cuttings
    1. Soft wood
    2. Hard wood
    3. Leaf cuttings
    4. Rooting media
    5. Root inducing hormones
    6. Containers
  F. Division
  G. Air layering (marcottage)
  H. Runners
  I. Propagation frame
    1. Glass enclosed box
    2. Plastic covered box
    3. Bell jar
  J. Seeds and spores
    1. Size of seeds
    2. Treatment
    3. Depth of sowing
  K. Grafting
    1. Understock
    2. Hybrid or variety
    3. Type of graft

III. Plant Growing Structures
  A. The greenhouse
    1. Semisteel and glass covered
    2. Orlyte
    3. Plastic-covered structures
    4. Conservatory
    5. Cold frames—hot beds
  B. The dwelling
    1. Sun porch
    2. Patio

    - 3. Window sill
    - 4. Any room in the house

IV. General Environment for Maximum Plant Growth
  - A. Light
    - 1. Daylight
    - 2. Artificial light
    - 3. Shading
  - B. Temperature
    - 1. Normal summer temperatures
    - 2. Winter heating
    - 3. Fuel
      - a. Oil
      - b. Electric
      - c. Coal
      - d. Natural or manufactured gas
    - 4. Automatic controls
      - a. Thermostat
      - b. Automatic ventilator
      - c. Humidifiers
  - C. Humidity
    - 1. Methods of increasing
    - 2. How to measure
    - 3. Control

V. Containers: Pots and Planters
  - A. The clay flower pot
    - 1. Standard size
    - 2. Azalea pot
    - 3. Bulb pans
    - 4. Rose pot
    - 5. Advantages and disadvantages
  - B. Plastic flower pots
    - 1. Sizes
    - 2. Less aeration
    - 3. Frequency of watering
    - 4. Rim breakage
    - 5. Advantages and disadvantages
  - C. Planters and window boxes
    - 1. Materials most suitable
    - 2. Wood, metal or plastic
    - 3. Forms and sizes
  - D. Jardiniers
    - 1. Earthenware
    - 2. Metal
    - 3. Plastic

VI. Watering Methods and Needs
  - A. Hand surfaces
  - B. Capillarity from the bottom
  - C. Retention of moisture over longer period of time
    - 1. Water in plant tray
    - 2. Placing pot in oversize jardinier
    - 3. Plant tray with constant water level
    - 4. Injection method
  - D. Frequency of watering
    - 1. Color of clay pot
    - 2. Color of soil
    - 3. Weight of plant
    - 4. Season of year
    - 5. Stage of plant growth

VII. Insect and Disease Control: Care of Plants in the Home
  - A. Clean culture
    - 1. Washing the leaves
    - 2. Spraying
    - 3. Rouging
  - B. Choice of insecticides
    - 1. Nonpoisonous to humans
    - 2. Spray or dust
    - 3. Fumigants
  - C. Storage of insecticides
    - 1. Out of reach of children
    - 2. Proper labeling
    - 3. Under lock and key
  - D. Disease control
    - 1. Keep plants insect free
    - 2. Rouging
    - 3. Preventative sprays and dust

VIII. The Terrarium
  - A. Containers
    - 1. Wardian case
    - 2. Glass jars
    - 3. Aquariums
    - 4. Goblets
    - 5. Bottles
    - 6. Glass or plastic covers
  - B. Soil
    - 1. Loam
    - 2. Peat and leafmold
    - 3. Sand and perlite
    - 4. Drainage and use of charcoal
  - C. Planting procedure
    - 1. Selection of plants
    - 2. Soil and drainage
    - 3. Moss and stones
    - 4. Arrangement and design
    - 5. Figurine
  - D. Water and moisture
  - E. Care

IX. The Dish Garden
  - A. Selection of container
    - 1. Form and design

        2. Depth
    B. Selection of plants
        1. Growing media
        2. Arrangement and design
    C. Water and humidity

X. Overall Care of House Plants
    A. Fertilizing
        1. Water soluble
        2. Dry
        3. Amount of application
        4. How often
    B. Repotting
        1. Pot
        2. Soil
    C. Training of plants
        1. Pinching
        2. Pruning
        3. Staking

Recommended Laboratory Projects—32 hours

I. Study indoor plants, their nomenclature, ecology, cultural requirements, and propagation (18 hours).

II. Examine plant growing structures and prepare a report on those which illustrate important features (2 hours).

III. Care for a group of house plants as directed (2 hours).

IV. Propagate plants by different methods (2 hours).

V. Practice insect and disease control on honse plants (2 hours).

VI. Practice watering, temperature and humidity control (2 hours).

VII. Make and care for a terrarium (2 hours).

VIII. Make and care for a dish garden (2 hours).

Texts and References

FREE. *All About House Plants.*
GRAF. *Exotica.*
LAURIE, KIPLINGER, *and* NELSON. *Commercial Flower Forcing.*
McDONALD. *The World Book of House Plants.*
Trade Publications:
    Florist and Nursery Exchange.
    Florists' Review.
    Growers' Talks.

Instructional Aids

Collection of 2" x 2" color slides of plants, dish gardens and terrariums

HOUSE AND CONSERVATORY PLANTS II

Hours Required

Class, 1; Laboratory, 2

Course Description

A continuation of House and Conservatory Plants I with emphasis on some of the more unusual plants. A major emphasis is the study of additional plants and their uses, and new developments in horticultural practice.

Major Divisions

		Class Hours
I.	Environment and Grouping of Plants	2
II.	Introduction to the Orchid Family	2
III.	Study of Cacti and Other Succulents	2
IV.	Study of the Begonia Family	2
V.	Study of Ferns (Filices)	2
VI.	Study of Bonsai Plants	2
VII.	Study of the Gesneriaceae	2
VIII.	Study of the Bromeliaceae	2
	Total	16

Units of Instruction

I. Environment and Grouping of Plants
- A. Plants for the north window
  - 1. Semishaded location
  - 2. Plants requiring little or no direct sun
    - a. Calathea
    - b. Aspidistra
    - c. Cissus
    - d. Episcia
    - e. Hedera
    - f. Nephrolepis
    - g. Nephtytis
    - h. Others
- B. Plants for the south window
  - 1. Sunny location
  - 2. Plants requiring full sunlight
    - a. Agave
    - b. Aloe
    - c. Azalea
    - d. Carissa
    - e. Citrus
    - f. Coleus
    - g. Gardenia
    - h. Impatiens
    - i. Geranium
    - j. Others
- C. Plants for a shady location
  - 1. In shade in center of room, or northern exposure
  - 2. Plants that do well in low light intensity
    - a. Sansevieria
    - b. Scindiapsus
    - c. Chlorophyta
    - d. Ficus
    - e. Aspidistra
    - f. Others
- D. Plants that prefer coolness
  - 1. Day and night temperatures
  - 2. Location of plants
  - 3. Plants liking cool temperatures
    - a. Acacia
    - b. Aucuba
    - c. Calluna
    - d. *Camellia*
    - e. Erica
    - f. Hedera
    - g. Ligularia
    - h. Others

II. Introduction to the Orchid Family
- A. Tropical Asia
  - 1. Calanthe
  - 2. Coelogyne
  - 3. Cymbidium
  - 4. Dendrobium
  - 5. Phalaenopsis
  - 6. Vanda
- B. Tropical America
  - 1. Brassavola
  - 2. Brassia
  - 3. Cattleya
  - 4. Epidendrum
  - 5. Lycaste
  - 6. Miltonia
  - 7. Oncidium
  - 8. Odontoglossum
  - 9. Stanhopea
- C. Africa
  - 1. Lisschilus
  - 2. Polystachya
  - 3. Ansellia
- D. Australia
  - 1. Bulbophyllum
  - 2. Eria
  - 3. Spathoglottis
- E. Temperate zones of Europe and North America

        1. Cypripedium
        2. Orchis
        3. Odontoglossum
    F. Growing medias
        1. Terrestrials (grow in soil)
        2. Mixture of osmunda fiber and soil or peat moss
        3. Epiphytes (airplant)—potting medias
            a. Osmunda fiber
            b. Redwood chips
            c. Tanbark
    G. Environment and culture
        1. Light
        2. Shade
        3. Water and moisture
        4. Feeding
        5. Temperatures
    H. Values
        1. Collectors or botanical
        2. Commercial cut flower production
    I. Handling
        1. Cutting
        2. Packing and shipping
        3. Storage temperatures

III. Study of Cacti and Other Succulents
    A. Succulents
        1. Definition
        2. Where succulents grow
    B. The cactus family
        1. What are cacti?
        2. History and nomenclature
        3. The leafy cacti
        4. The prickly pears
        5. The torch cacti
        6. Climbing cacti
        7. Barrel cacti
    C. The amaryllis family
        1. Agave
        2. Senecio
        3. Kleinia
        4. Othonna
    D. The study of the crassula family
        1. Crassula
        2. Adromischus
        3. Cotyledons
        4. Kalanchoe
        5. Bryophyllum
        6. Sedum
        7. Echeveria
    E. The study of the euphorbia family
        1. Euphorbia splendens
        2. Euphorbia obesa
        3. Euphorbia mammillaria
    F. The study of the lily family
        1. Aloe
        2. Haworthia
        3. Gasteria
    G. The study of the nesembryanthemum family
        1. Faucaria
        2. Lithops
        3. Trichodiadema
    H. The milkweed family
        1. Stapelia
        2. Huernia
        3. Ceropegia
    I. Other succulent families
        1. Portulacaria
        2. Pelargonium
        3. Cissus
        4. Tradescantia
    J. Succulents in the home
        1. Succulents as house plants
        2. Containers and potting
        3. Propagating
    K. Study of the maintenance of cacti and other succulents
        1. Moisture
        2. Growing medias and food
        3. Air, light and shade
        4. Resting

IV. Study of the Begonia Family
    A. Fibrous-rooted begonias (Semperflorens)
    B. Rhizomatous begonia
    C. Rex begonia
    D. Tuberous-rooted begonias
    E. General culture
        1. Location
        2. Temperature
        3. Moisture and water
        4. Soil and fertilizer
        5. Light
        6. Propagation methods
            a. Cuttings
            b. Seed
        7. Varieties

V. Study of Ferns (Filices)
    A. Species
        1. Polypodiaceae
        2. Cyatheaceae
        3. Dickoniaceae
    B. Propagation
        1. Division

    2. Plantlets
    3. Spores
    4. Suckers
  C. Culture in the home
    1. Species and varieties
    2. Environment
    3. Pest control
  D. Fern terrarium
    1. Species
    2. Varieties

VI. Study of Bonsai Plants
  A. Origin of bonsai
    1. Japan
    2. Western gardeners
  B. Selection of plants
    1. Japanese white pine
    2. Miniature spruce trees
    3. Japanese yew
    4. Japanese maple
    5. Kurume azaleas
    6. Gray barked elm
  C. Collection of plants
    1. On mountain cliffs
    2. Dry rocky slopes
    3. Buying plants
    4. Grown from seeds
    5. Cuttings
    6. Grafting and layering
  D. Containers
    1. Ceramic trays
    2. Pans or dishes
    3. Color
    4. Size and depth
  E. Soil for bonsai
    1. Clay
    2. Loam
    3. Sand
    4. Humus
    5. Plant food
  F. Potting of bonsai (tools used)
  G. Shaping and pruning
  H. Wiring and bending
  I. Maintenance
    1. Watering
    2. Feeding
    3. Pest control

VII. Study of the Gesneriaceae
  A. Species
    1. Gloxinia
    2. Saintpaulia
    3. Columnea
    4. Episcia
    5. Nemantanthus
    6. Aechynanthus
    7. Smithiantha
  B. Propagation methods
    1. Seeds
    2. Leaf cutting
    3. Stem cutting
    4. Division
  C. Home culture
    1. Enviroment
    2. Light
    3. Pest control

VIII. Study of the Bromeliaceae
  A. Species
    1. Aechimea
    2. Ananas
    3. Billbergia
    4. Bromelia
    5. Cryptanthus
    6. Dyckia
    7. Neoregelia
    8. Guzmani
    9. Uriesea
    10. Tillandsia
  B. Propagation
    1. Offshoots
    2. Cutting
    3. Seed
  C. Culture in the home
    1. Environment
    2. Water
    3. Plant food
    4. Pest control
    5. Growing medias
    6. Potting and repotting

Recommended Laboratory Projects—32 hours

I. Ventilate, water, and provide overall care for conservatory plants (4 hours).
II. Fertilize house and conservatory plants (2 hours).
III. Pot and repot plants studied (4 hours).
IV. Prune and shape laboratory plants (2 hours).
V. Seed house and conservatory plants (4 hours).
VI. Propagate plants by cuttings (4 hours).
VII. Propagate plants by layering (2 hours).
VIII. Propagate plants by dividing (2 hours).
IX. Propagate plants by spores (2 hours).

X. Propagate group plantings (2 hours).
XI. Practice insect and disease control and prepare a calendar for such (4 hours).

Texts and References

GRAF. *Exotica.*
FREE. *All About House Plants.*
MCDONALD. *The World Book of House Plants.*
Trade Publications:
  Florist and Nursery Exchange.
  Florists' Review.

Instructional Aids

Collection of 2" x 2" color slides
Plant collections in greenhouses
Photographs of plants and flowers

INDOOR LANDSCAPING

Hours Required

Class 1; Laboratory, 2

Course Description

An advanced course making use of tropical plants studied in House and Conservatory Plants I and II. From 100 to 150 new plants are studied, with particular emphasis on some of the unusual plants in the group.

In the laboratory, students draw plans and elevations of room interiors which show placement of plants and their value to the decorating scheme. The details of layout, design, plan, rendering, cost finding, contracts and specifications, and estimating are emphasized.

Major Divisions

	Class Hours
I. Introduction	1
II. Principles of Design	2
III. Types of Indoor Landscaping	2
IV. Plant Containers and Planting Areas	2
V. Design Procedure	3
VI. Radiant Energy	6
Total	16

Units of Instruction

I. Introduction
  A. The field of indoor landscaping
    1. History
    2. Development factors
      a. Light and lighting techniques
      b. Architectural advancement
      c. Availability of foliage plants
      d. Introduction of new species
      e. Artificial plants
      f. Development of containers
    3. Opportunities for use
    4. Employment opportunities

II. Principles of Design
  A. Application to indoor landscaping
    1. Focalization
      a. Center of interest
      b. Graduation
      c. Sequence
    2. Unity—methods of achievement
      a. Control of area
      b. Line
      c. Pattern
      d. Materials
    3. Balance
      a. Symmetrical
      b. Asymmetrical
      c. Weight
      d. Volume
    4. Scale
      a. Size
      b. Proportion
      c. Relativity
    5. Simplicity
      a. Control number materials
      b. Control variety materials
      c. Restraint in design
  B. Principles of composition
    1. Transition
    2. Opposition and contrast
      a. Color
      b. Line
      c. Texture
      d. Scale
    3. Repetition
      a. Value
      b. Monotony
    4. Rhythm, its meaning in design
    5. Harmony
      a. Color
      b. Line
      c. Form
    6. Color
      a. Perceptual
      b. Spectrum
      c. Color wheel
      d. Shadow
      e. Light
    7. Texture
      a. Fine
      b. Medium
      c. Coarse

III. Types of Indoor Landscaping
  A. Private homes
    1. Entrance
    2. Windows
    3. Combining indoor and outdoor planting
  B. Public buildings
    1. Religious
    2. Educational
    3. Recreational
    4. Commercial

        - a. Banks
        - b. Offices
        - c. Lobbies
        - d. Reception rooms
  - C. Cultural factors to consider
    - 1. Light availability
      - a. Natural sunlight
      - b. Intensity
      - c. Duration
    - 2. Artificial light
      - a. Supplement to natural light
      - b. Sole source
    - 3. Temperature
      - a. Minimum
      - b. Optimum
      - c. Maximum
    - 4. Moisture
    - 5. Humidity control
    - 6. Soil
      - a. Requirements of plants
      - b. *p*H control
      - c. Nutrition
    - 7. Toxic agents
      - a. Dust
      - b. Cooking gas
      - c. Heating equipment fumes
      - d. Metals
    - 8. Maintenance procedures
      - a. Need
      - b. Extent

- IV. Plant Containers and Planting Areas
  - A. Planter requirements
    - 1. Size
      - a. Width
      - b. Depth
    - 2. Drainage
    - 3. Durability
      - a. Weight
      - b. Strength
      - c. Mobility
      - d. Resistance to rotting
      - e. Resistance to rusting
    - 4. Protection
      - a. Paint
      - b. Chemicals
  - B. Materials for construction
    - 1. Wood
    - 2. Concrete
    - 3. Brick
    - 4. Metal
    - 5. Plastic
    - 6. Ceramic
    - 7. Glass
    - 8. Asphaltum liners
    - 9. Metal liners
  - C. Provisions for maintenance
    - 1. Watering
    - 2. Drainage
    - 3. Fertilization
    - 4. Manual
    - 5. Automatic
    - 6. Semiautomatic

- V. Design Procedure
  - A. Client interview
    - 1. Needs
    - 2. Budget allowance
    - 3. Habits and mode of living
    - 4. Style of architecture
    - 5. Style of decor
    - 6. Limiting factors
    - 7. Contracts and specifications
  - B. Physical survey
    - 1. Tape measure
    - 2. Sketch or graph paper pad
    - 3. Pencils
    - 4. Light meter readings
      - a. Morning
      - b. Mid-day
      - c. Late afternoon
    - 5. Polaroid
  - C. Preliminary plans
    - 1. Sketches in perspective
    - 2. Line drawing of plan
    - 3. Review with client
  - D. Final plans
    - 1. Sketches in perspective
    - 2. Line drawings of plan

- VI. Radiant Energy
  - A. Spectrum of electromagnetic radiation
    - 1. Invisible portion
      - a. Means of measurements
      - b. Terminology
    - 2. Visible portion
      - a. Natural daylight
      - b. Means of measurement
      - c. Terminology
    - 3. Velocity and speed of light
  - B. Light and its properties
    - 1. Wave lengths and vibrations
    - 2. Emission of photons
    - 3. Source of plant energy
    - 4. Theories of light
      - a. Newton—1666

        b. Nuygens—1700
        c. Combination of above
    5. Reflection
    6. Absorption
    7. Refraction
    8. Diffraction
    9. Dispersion
    10. Interference
    11. Polarization
    12. Doppler effect
    13. Quantum of light
    14. Photon
C. Influence of light on plant growth
    1. Photosynthesis
    2. Colored light influence
        a. Fluorescent
        b. Incandescent
        c. Other rays
D. Measurement of radiant light
    1. Intensity
    2. Duration
    3. Total light available
    4. Standards of light intensity
        a. Natural sunlight
        b. Indoors
E. Foliage plants light requirements
    1. Low-light (15–25 f.c.), list specific plants
    2. Medium-light (25–50 f.c.), list specific plants
    3. High-light (50–100 f.c.), list specific plants
    4. Special requirements, list specific plants
F. Photoperiodism
    1. Short day
    2. Long day
    3. Plant requirements
        a. Foliage plants
        b. Flowering plants
G. Types of artificial light
    1. Fluorescent
    2. "Gro-Lux"
    3. Incandescent
    4. Mercury vapor
    5. Infra-red

Recommended Laboratory Projects

I. Identify 10 to 15 plants each week by association of taxonomic terms and observation of plant characteristics (10 hours).

II. Identify by scientific name, plants designated in monthly field quiz (4 hours).

III. Prepare a complete indoor planting design for the living room of a small home (6 hours).
Required Drawings:
A. Elevation of room showing placement of proposed containers with plantings and location of lighting devices.
B. Plan of room showing proposed placement of containers with planting.
C. One-point perspective of room showing proposed indoor landscaping.

IV. Prepare a complete indoor planting design for the entrance foyer of a commercial building (6 hours).
Required Drawings:
A. Elevation of room showing placement of proposed containers with plantings and location of lighting devices.
B. Plan of room showing proposed placement of containers with planting.
C. One-point perspective of room showing proposed indoor planting.

V. Prepare a complete indoor planting design for a church, bank, or reception room of a public building (6 hours).
Required Drawings:
A. Elevation of room showing placement of proposed containers with plantings and location of planting devices.
B. Plan of room showing proposed placement of containers with plantings.
C. Two-point perspective of room showing proposed indoor planting.

Texts and References

FREE. *All About House Plants.*
GRAF. *Exotica III.*
NOBLE *and* MERKEL. *Plants Indoors.*
NORLING. *Perspective Drawing.*
SCHARFF. *The Book of Planters.*
SCHULZ. *Growing Plants Under Artificial Light.*

Instructional Aids

2″ x 2″ color slides
16 mm. films
Magazine and trade publication illustrations and articles

LANDSCAPE CONSTRUCTION

Hours Required

Class, 1; Laboratory, 3

Course Description

This course teaches the techniques and use of materials for constructing various small landscapes. It provides the basic knowledge and skills needed for planning and constructing garden terraces, walks, walls, fences, benches, and garden pools.

The knowledge learned in lectures and assignments is applied in the design and construction of landscape features for the horticultural gardens of the institution. The projects selected for construction should become a permanent part of the institution's gardens and serve as examples to help students advance in construction skills and understand good construction practices.

Concrete, stone, bricks, concrete blocks, and asphalt are among the materials used for pavement, wall and pool construction. The course also provides instruction in materials and techniques used for fence and terrace cover construction, proper drainage and irrigation, and area building restrictions.

Figure 13.—Resourceful use of experimental plots and materials can provide practice in various types of landscape construction.

Major Divisions

	Class Hours
I. Course Introduction	1
II. Concrete Uses and Proportioning	2
III. Paving—Design and Materials	5
IV. Walls—Retaining and Free Standing	1
V. Steps—Design Proportions and Construction	1
VI. Terraces and Patios	2
VII. Garden Pools and Streams	1
VIII. Fences—Kinds and Placement	1
IX. Drainage and Irrigation	2
Total	16

Units of Instruction

- I. Course Introduction
  - A. Objective of course
  - B. Terminology
    - 1. General terms
    - 2. Start glossary of construction terms
  - C. File card system
    - 1. Use as a term project
    - 2. Useful with design problems
    - 3. Rapid reference after graduation
- II. Concrete Uses and Proportioning
  - A. Introductory considerations of concrete work and predetermining quality
    - 1. Water-cement ratio strength law
    - 2. Plasticity
    - 3. Economy factors
    - 4. Form requirements
    - 5. Mixing, placing, finishing, and curing concrete
    - 6. Footings and drains
  - B. Portland cement
    - 1. History and definition
    - 2. Requirements of composition—specifications
  - C. Proportions—materials
  - D. Mixing and handling procedures
    - 1. Plan
    - 2. Mix
    - 3. Finish
      - a. Float—wood and steel
      - b. Trowel
      - c. Brush
  - E. Rules
    - 1. Fuller's rule
    - 2. Proportional rule
  - F. Forms and reinforcing
  - G. Types of joints
- III. Paving—Design and Materials
  - A. Walks and driveways
    - 1. Alinement
    - 2. Grades
    - 3. Drainage
    - 4. Foundation
    - 5. Capacity
    - 6. Curbs
    - 7. Materials
    - 8. Patterns
  - B. Concrete
    - 1. Definition
    - 2. Determine volume
      - a. Shrinkage
      - b. Waste
    - 3. Tests for strength
      - a. Compressive strength
      - b. Tensile strength
      - c. Flexural strength
    - 4. Slump test
    - 5. Rubble concrete
    - 6. Mortar
    - 7. Paste
    - 8. Costs
  - C. Brick
    - 1. Planned use of area—traffic
    - 2. Patterns
    - 3. Base
      - a. Sand
      - b. Concrete
    - 4. Template
    - 5. Materials—kind of brick or other materials
    - 6. Procedure
    - 7. Tools
    - 8. Costs
  - D. Stone
    - 1. Types and characteristics
    - 2. Patterns
    - 3. Combinations
    - 4. Planned use of area
    - 5. Thickness
    - 6. Base
      - a. Sand
      - b. Concrete
    - 7. Procedures
    - 8. Tools
    - 9. Costs
  - E. Soil-cement and asphalt
    - 1. Types of soil-cement
      - a. Compacted soil and cement
      - b. Cement and modified soil
      - c. Plastic soil and cement
    - 2. Composition
    - 3. Uses
    - 4. Procedures for construction
    - 5. Finishes
    - 6. Costs
    - 7. Asphalt
      - a. Types
      - b. Composition
      - c. Uses
      - d. Procedures for construction
      - e. Costs

IV. Walls—Retaining and Free Standing
  A. Definitions of common terms
  B. Types of masonry
    1. Rubble
      a. Uncoursed
      b. Coursed
    2. Ashlar
      a. Ranged
      b. Broken range
      c. Random range (coursed)
      d. Random range (interrupted coursed)
    3. Brickwork
      a. Kinds of brick
      b. Brick bonds
      c. Joints
  C. Types of walls
    1. Free-standing walls
    2. Retaining walls
      a. Batters
      b. Strength requirements

V. Steps—Design Proportions and Construction
  A. General discussion
  B. Design aspects
    1. Rules (tread-riser proportions)
      a. Olmsted
      b. Boston
    2. Material combinations
    3. Comfort
    4. Intended use
    5. Elevation; horizontal distance ratio
  C. Construction
    1. Drainage and footings
    2. Cheek walls
    3. Reinforcement
      a. Rods
      b. Mesh

VI. Terraces and Patios
  A. Planned usage
  B. Covered or exposed
  C. Materials
    1. Stone
      a. Descriptions
      b. Patterns
    2. Brick
      a. Kinds
      b. Patterns
    3. Concrete
      a. Premixed
      b. Precast
      c. Reinforced
  D. Drainage
  E. Construction procedures

VII. Garden Pools and Streams
  A. Formal, informal and naturalistic pools
    1. Reinforced concrete
    2. Stone
    3. Brick
    4. Clay
    5. Fiberglass
  B. Problems of stream building
    1. Methods
    2. Materials
  C. Water supply and treatment
    1. Natural source
    2. Circulating pumps
    3. Plumbing
    4. Drainage
  D. Fountains and waterfalls

VIII. Fences—Kinds and Placement
  A. Kinds
    1. Stockade
    2. Post and rail
    3. Board
    4. Basketweave
    5. Louver
    6. Wire
  B. Uses
  C. Placement procedures
    1. Drainage provisions for posts
    2. Alinement
    3. Level
  D. Comparative costs and lasting qualities
  E. Preservatives

IX. Drainage and Irrigation
  A. Drainage
    1. Purposes
    2. Principles
    3. Areas requiring drainage and problems of each
    4. Kinds of tile used
    5. Computing sizes of pipes
      a. Surface water
      b. Ground water
    6. Determining locations and patterns
    7. Setting lines and grades
    8. Excavating trenches
    9. Laying pipes
    10. Backfilling trenches
  B. Irrigation
    1. General consideration and common errors

2. Distribution
3. Conveyance and storage
4. Materials used
5. Outlets
6. Rates of consumption
7. Sources of supply

Recommended Laboratory Projects—48 hours

Note: Some of the suggested landscape projects may have been completed by other groups of students to serve as permanent structures or features in the institution's gardens. If this is so, the permanent installations may be repaired as part of the maintenance and renovation requirement to accomplish the instruction recommended for this part of the course.

I. Begin file card system. Introduce the group to the concrete tools and demonstrate their uses. Prepare small quantities of lime-mortar and direct the students in the proper handling of the tools (3 hours).

II. Present this laboratory exercise in two sections. First have the students mix concrete by hand, pour into forms, and use finishing tools. In this way the mixture is not wasted and the concrete slabs can be used in permanent structures. The second section of laboratory study can focus on machine-mixed concrete and finishing techniques for precast units (6 hours).

III. Familiarize the students with various paving materials and construction procedures used in developing walkways and paths in the departmental instruction garden. It is recommended that instruction be given in concrete, brick, flagstone and soil-cement paving techniques (15 hours).

IV. Develop a problem that introduces students to garden wall construction. Have them construct a garden wall; use as a permanent installation, if possible (3 hours).

V. Measure several step treads and risers, after which the students should use them and prepare comments on their comfort prior to attending the laboratory. Construct several steps with timber, concrete, stone, brick, or combinations of these materials (3 hours).

VI. Develop a problem that entails the procedures required for the construction of a terrace or patio. It may be just an area within the instruction garden large enough for several people to congregate and could include one or several benches designed and constructed by the students (6 hours).

VII. Construct a water feature. This could be part of a long-term project (3 hours).

VIII. Construct and erect a fence and/or gate within the garden (3 hours).

IX. Install an irrigation or drainage system within the garden (6 hours).

Texts and References

PARKER. *Simplified Design of Reinforced Concrete.*
———. *Simplified Design of Structural Timber.*
PORTLAND CEMENT ASSOCIATION. *A Practical Course in Concrete.*
———. *Cement Mason's Manual.*
———. *Soil-Cement Construction Handbook.*
STEWART. *Planning and Building Your Patio.*
SUNSET. *Garden and Patio Building Book.*
———. *How to Build Patio Roofs.*
———. *Swimming Pools.*

Instructional Aids

2″ x 2″ color slides
Campus gardens and construction features
Various kinds of plans prepared by professional designers and landscape architects
Selected technical bulletins approved and/or prepared by colleges, universities, the A.I.A. and the A.S.L.A.

LANDSCAPE GARDENING

Hours Required

Class, 1; Laboratory, 6

Course Description

A course designed to develop the students' knowledge of ornamental gardens and landscape beautification by providing experience in planning, rehabilitation, care, development, and operation of gardens. Field practices are combined with classroom theory in many related subjects. Plans for actual landscape gardening must be flexible enough for adaptation to the climate, season, weather, and instructional facilities. The major emphasis is on the laboratory activities which provide students with experience in landscape gardening.

Major Divisions

	Class Hours
I. History of Gardening	2
II. Principles of Design and Composition	3
III. Garden Planning	3
IV. Garden Operations	8
Total	16

Units of Instruction

- I. History of Gardening
  - A. Influences on garden development
    - 1. Sociopolitical
    - 2. Economic
    - 3. Climatic
    - 4. Topographic
  - B. Chronology
    - 1. Ancient gardens
      - a. Egyptian
      - b. Mesopotamian
      - c. Greek
      - d. Roman
    - 2. Medieval gardens
      - a. Persian
      - b. Moorish
      - c. European
    - 3. Renaissance
      - a. Italian
      - b. French
      - c. English
      - d. American
    - 4. Oriental
      - a. China
      - b. Japan
- II. Principles of Design and Composition
  - A. Principles of unity, harmony, balance, rhythm and focus
  - B. Elements of design and composition
    - 1. Line, direction and shape
    - 2. Size, proportion and texture
    - 3. Color and value
- III. Garden Planning
  - A. Lettering styles and spacing
  - B. Drafting layout margin, scale and title block
  - C. Plan development
  - D. Perspective drawing
    - 1. Vanishing points
    - 2. Horizons
    - 3. Picture plane
  - E. Landscape sketching
    - 1. Pencil techniques and shadows
    - 2. Composition and scale
- IV. Garden Operations
  - A. Rehabilitation
    - 1. Lawns, shrubs and hedges
    - 2. Herbaceous plants and roses
  - B. Garden development
    - 1. Layout of projected development
    - 2. Installation of irrigation
    - 3. Soil operations
      - a. Excavation
      - b. Grading
      - c. Improvement
    - 4. Walks
      - a. Renovation
      - b. Construction
    - 5. Planting
      - a. Trees and shrubs
      - b. Hedges and herbaceous material
    - 6. Edging
      - a. Lawns
      - b. Walks
      - c. Beds

Recommended Laboratory Projects—96 hours

- I. Write and illustrate an essay on an assigned topic, such as a medieval cloister garden, replete with medicinal, culinary, and aromatic herbs. Append a list of such herbs and their uses (6 hours).

II. Prepare plates to illustrate principles of design and composition (6 hours).

III. Sketch local landscapes as directed (6 hours).

IV. Prepare the plan for a garden or enclosed area to be established on campus or at home (12 hours).

V. Rehabilitate and maintain lawns, shrub areas, and gardens, and control pests (36 hours).

VI. Develop new gardens, including soil operations, irrigation, planting, and special features (30 hours).

Texts and References

BUSH-BROWN. *America's Garden Book.*

JANICK. *Horticultural Science.*

PYENSON. *Keep Your Garden Healthy.*

ROCKWELL *and* GRAYSON. *Complete Guide to Successful Gardening.*

Instructional Aids

Lawn, shrub, garden, and landscaped areas
Garden plans
Photographs and slides of gardens
Collections of plants
Hot beds, cold frames and greenhouse

LANDSCAPE PLANS I

Hours Required

Class, 1; Laboratory, 6

Course Description

An introductory study of the theory and principles of landscape design as they are applied to selected problems, both hypothetical and actual, in landscape development. Preliminary sketches and final drawings are prepared in plan, elevation, and perspective form. As the course progresses, problems of landscape design require additional study, creativity, and detailed solutions to incorporate the information learned in the lectures.

The course begins with a review of basic drawing and drafting procedures, followed by a comprehensive study of the history of landscape design. It presents the characteristics of ideal planning, the reasons for planning, and the various types of plans as essential to translating the designer's ideas on paper to serve as guides for completed projects. Emphasis is placed on design principles to provide each student with a basis for preparing original, beautiful and utilitarian plans. Planting design monopolizes most of the course time, but some time is spent on the design and use of architectural features for the garden. Consideration is given to residential property (driveways, walks, and traffic circulation are of prime importance).

A collection of slides are used in the lectures, and as the course progresses the laboratory projects include student visitations to actual problem sites. Campus and faculty home sites are utilized for studies and examples of designs.

Major Divisions

		Class Hours
I.	Review of Basic Drawing and Drafting Techniques	1
II.	History of Landscape Design	2
III.	Characteristics of Ideal Planning	2
IV.	Principles of Design	3
V.	Areas of Residential Properties	3
VI.	Architectural Garden Features	3
VII.	Traffic Circulation—Walks and Driveways	2
	Total	16

Units of Instruction

I. Review of Basic Drawing and Drafting Techniques
  A. Pencil techniques
  B. Plans and elevations
  C. Perspective drawing procedures

II. History of Landscape Design
  A. Egyptian, Grecian, Roman, and Oriental (prior to 1000 AD)
  B. Italian, Spanish, French, and English (since 1000 AD)
  C. European compared to American (1400–1800)
  D. American (1800 to present)
    1. 1800–1880
    2. 1880–1945
    3. 1945–present

III. Characteristics of Ideal Planning
  A. Beauty and utility
  B. Reasons for planning
    1. Economy
    2. Charm and usefulness
    3. Greater enjoyment of outdoors
    4. Expression of taste and personality
  C. Definition of a plan
  D. Specific types of plans
    1. Survey or plot
    2. Topographic
    3. Grading
    4. Construction
    5. Planting
    6. Detail
    7. Presentation

IV. Principles of Design
  A. Simplicity
  B. Opposition
  C. Transition
  D. Repetition
  E. Scale
  F. Balance

V. Areas of Residential Properties
  A. Public and/or approach
    1. Main entrance
    2. Foundations
  B. Private
    1. Living
    2. Garden (ornamental)

C. Utility
  1. Service
  2. Garden (vegetable)

VI. Architectural Garden Features
  A. Enclosures: privacy and protection—walls, fences, and plants
    1. Concrete, stone, brick, wood, plastics, etc.
    2. Plants—hedges or shrub borders
      a. Formal
      b. Informal
  B. Steps—Olmstead rule
    1. Higher the riser more narrow the tread
    2. Risers 4-6 inches
    3. Treads 14-20 inches
  C. Benches
    1. Stone, concrete or brick
    2. Wood
  D. Water
    1. Pools and fountains
    2. Streams and waterfalls
  E. Alpine units using rocks and boulders
  F. Animal feeders
  G. Garden houses
  H. Sculpture and statuary

VII. Traffic Circulation—Walks and Driveways
  A. Direct route
  B. Minimum of curves
  C. Strong consideration for original topography, when possible
  D. Walks
    1. Dimensions
      a. Entrance
      b. Utility and service
      c. Garden path
      d. General rule—2½ ft. per person
      e. Speed variation inside *vs.* outside
    2. Design—materials
      a. Gravel
      b. Field and riverbed stone
      c. Asphalt
      d. Turf
      e. Brick
      f. Flagstone
      g. Wood chips
      h. Tanbark
      i. Concrete
  E. Driveways—straight compared to curved
    1. Materials
      a. Asphalt
      b. Stone
      c. Concrete
    2. Design
      a. Width
      b. Alinement
  F. Drainage, the most important of all construction features
  G. Perron, ramp-walk combination

Recommended Laboratory Projects—96 hours

I. Prepare a designated hypothetical and simple residential problem, completely labeled, in a predetermined scale (12 hours).

II. Develop a hypothetical problem in landscape design pertinent to one nation (Unit II) during a specific historical era (6 hours).

III. Study samples of specific plans and use laboratory project II to develop planting and construction studies (12 hours).

IV. Design small on-campus planting and construction features. This project should be included because it stresses the importance of needing accurate onsite measurements and notations to prepare a plan and elevation (18 hours).

V. Introduce the techniques of client interview. For this project, a non-departmental faculty member provides his property as the space to be landscaped and is interviewed by the students. The students draw a plan to fulfill the general requirements, giving emphasis to utility and beauty in usage of space (18 hours).

VI. Plan a second onsite project and include a faculty member whose ideas require the students to provide two elevations and design details along with a plan and the additional specific requirements (18 hours).

VII. Develop a final term project more detailed in design than project V or VI and which emphasizes privacy, space usage, and traffic circulation. Presentation requirements include a plan and a perspective with appropriate design notes and an attractive, complete title (12 hours).

Texts and References

AUL. *How to Plan Modern Home Grounds.*
———. *How to Plant Your Home Ground.*
BUSH-BROWN. *America's Garden Book.*
ECKBO. *The Art of Home Landscaping.*
ORTLOFF and RAYMORE. *The Book of Landscape Design.*
———. *Color and Design for Every Garden.*
SUNSET. *Landscaping for Modern Living.*

Instructional Aids

Models of residential and industrial sites
2" x 2" color slides
Campus gardens and plant materials
Various kinds of plans prepared by professional designers and landscape architects

LANDSCAPE PLANS II

Hours Required

Class, 1; Laboratory, 9

Course Description

Landscape Plans II is a continuation of Landscape Plans I. In order to prepare the students for situations similar to those in industry, the pace of instruction and class contact hours are increased.

The course emphasizes plant groupings, their uses according to ecological and climatic requirements, and their design effectiveness. Throughout the course, the importance of uncluttered open areas is stressed, whether the student is concerned with large lawn areas or small intimate sections of the total design. The economics of each design varies and receives much attention because students seldom have unlimited funds for projects once they are graduated. It has been found that economic restrictions present the most realistic and practical problems in landscape planning. Under severe financial restrictions, students develop techniques to solve difficult landscape problems and therefore find other problems simple to solve.

The lectures and laboratory projects continue as in Landscape Plans I, using campus and faculty home sites for laboratory problems. Selected field trips, garden show competitions and lectures by specialists from the field supplement the regular lectures and projects.

Major Divisions

	Class Hours
I. Open Areas and Features	2
II. Intimate Living Areas—Terraces and Patios	3
III. Location of Trees and Shrubs	4
IV. Herbaceous Plant Material Usage	2
V. Roses and Bulbs—Considerations	1
VI. Recreation Areas—Public and Private	2
VII. Industrial and Municipal Areas	1
VIII. Traffic Areas	1
Total	16

Units of Instruction

- I. Open Areas and Features
  - A. Lawns
    - 1. Uncluttered
    - 2. Set off complete design
    - 3. Avoid steep slopes
    - 4. Provide drainage
  - B. Feature
    - 1. Major
    - 2. Minor
    - 3. Types
      - a. Animal feeders
      - b. Plant materials—specimens and groupings
      - c. Sculpture and objects of art
      - d. Furniture
      - e. Walls and fences
      - f. Water
- II. Intimate Living Areas—Terraces and Patios
  - A. Fundamental differences
  - B. Part of house and garden—important requirements
    - 1. Location and accessibility
    - 2. Surface; paved or unpaved
    - 3. Size consideration
    - 4. Necessity of sun or shade
  - C. Kinds of terraces and patios
    - 1. Sun or shade (sunbathing or restfully cool)
    - 2. Dining and privacy
  - D. Materials
    - 1. Brick
    - 2. Flagstone
    - 3. Concrete
    - 4. Asphalt
    - 5. Composition
    - 6. Pebbles, chips or fieldstone
    - 7. Turf
    - 8. Tanbark, etc.
  - E. Overhead covers
    - 1. Plants (vines)
    - 2. Canvas
    - 3. Wood
    - 4. Plastic
    - 5. Other
- III. Location of Trees and Shrubs
  - A. Complement house, property and view
  - B. Blend with features
  - C. Use as features
  - D. Plants for climatic area and ecology
  - E. Maintenance ease
  - F. Trees

    1. Frame house and views
    2. Shade
    3. Beauty
    4. Privacy
  G. Considerations when using plants
    1. Texture
    2. Form
    3. Color (bloom, fruit, leaf, and bark)
    4. Size
    5. Shadow (light and dark)
    6. Mass
    7. Ecology and climate (exposure)
  H. Use of existing plants and other materials
  I. Facade plantings (adjacent to building foundations)
  J. Borders
  K. Specimen plants (selection and placement)

IV. Herbaceous Plant Material Usage
  A. Groups
    1. Perennials—minimum but persistent maintenance
    2. Annuals—maximum maintenance when young
      a. Fillers
      b. Separate beds
  B. Bed and border design
    1. Should blend with overall design
      a. Used separately as features
      b. Conformity to original design lines
      c. Minimum use of spectacular colors (reds distract and disturb—not restful)
      d. Use as facing or filler plants
    2. Relative space required
  C. Height as high in back and low in front
  D. Color
    1. Complex subject
      a. Suit personal tastes of clients
      b. Use sparingly
      c. Form and texture take precedent over color
    2. Gay in spring (reds and yellows)
    3. Cool in summer (pastels)
    4. Warm in fall (bronze)
  E. Depth illusion
    1. Brights seem close (in distance)
    2. Soft grays, greens and blues seem distant (peaceful)
  F. Uniformity of like flowers in same conditions at same time
  G. Formality compared to informality
    1. Formality usually does not hold attention long
    2. Informality can hold attention and interest but requires more study to develop
  H. Edging
    1. Formal gardens may have conspicuous edges
    2. Informal and naturalized gardens should have inconspicuous edges (not raised)
  I. Shrubs in herbaceous borders
    1. Often preferred to spot trees and shrubs within herbaceous beds
    2. Evergreen (coniferous and broadleaf) keep garden from being desolate in Winter

V. Roses and Bulbs—Considerations
  A. Bulbs
    1. Tulips, hyacinths, lilies, and iris (formalize easily)
    2. Narcissus, grape hyacinth, lilies, iris and crocus (naturalize easily)
  B. Roses (generally formal in beds)
    1. Types
      a. Climbers and ramblers
      b. Shrub
      c. Hybrid
      d. Grandiflora
      e. Floribunda
      f. Miniature
    2. Location in sunlit area
    3. Bed size
      a. One to 3 feet with one-side access
      b. Three to 5 feet with two-side access
    4. Paths within formal rose gardens
      a. Three to 6 feet width
      b. Grass or gravel surface
    5. Climber support
      a. Fence
      b. Trellis

VI. Recreation Areas—Public and Private
  A. Athletic areas
    1. Football
    2. Tennis
    3. Track and field
    4. Baseball and softball
    5. Soccer
    6. Hockey (field and ice)
    7. Other
  B. Parks
    1. National, State, and local

    2. Marinas
  C. Play Areas
    1. Badminton
    2. Croquet
    3. Swings, etc.
  D. Golf courses

VII. Industrial and Municipal Areas
  A. Schools
  B. Housing (public and private)
  C. Factories
  D. Garden and shopping center areas
  E. Libraries, museums and others

VIII. Traffic Areas
  A. Parking
    1. Minimum requirements
    2. Circulation
    3. Lighting
    4. Drainage
    5. Practicality
  B. Planning for ornamental landscaping of parking or traffic areas

Recommended Laboratory Projects—144 hours

I. Prepare a hypothetical plan for a residential property of 20,000 to 30,000 square feet. The skillful use of one major and at least two minor features, set off by large expanses of lawn, should carry the most weight. Presentation of the project is to be in plan and one perspective of a feature (18 hours).

II. Develop a complete plan with emphasis on a terrace or patio design for dining—sun and shade—with an interesting view of other areas of the garden which require privacy. Presentation requires a complete plan perspective of the terrace and a detail construction drawing of part of the terrace (27 hours).

III. Prepare a project for a garden enthusiast, emphasizing the uses of plant material groupings with inanimate features playing minor roles. The element of surprise and seasonal color succession should be emphasized. Presentation requires a plan of the entire garden with the introduction of a complete plant list and specifications for planting (36 hours).

IV. Develop a complete design that utilizes herbaceous plant materials as the major features. The design should involve lawn areas, terraces, and woody plant materials. The plan should be presented in ink and include a seasonal color chart for the herbaceous plants (18 hours).

V. Develop a complete residential property and emphasize roses in both formal and informal situations. The problem should be presented in color, preferably colored pencil (9 hours).

VI. Develop a problem that features recreation areas either public or private. It should consider the various requirements for several age groups and may be permanent or temporary for the toddler group. Consideration of plant materials is important. Presentation in color and ink of a complete plan is required (18 hours).

VII. Prepare a plan of a college facility, a local governmental facility, or a school. Emphasis should be placed on traffic circulation, plant material, maintenance, and cost. A complete detailed plan and plant list are presentation requirements. Color presentations are optional (9 hours).

VIII. The final term project should be the student's choice of a residential property with a complete study emphasizing outdoor living and traffic areas. Presentation may also be the student's choice, but must be complete and informative (9 hours).

Texts and References

BUSH-BROWN. *America's Garden Book.*
BUTLER. *Recreation Areas, Their Design and Equipment.*
CHURCH. *Gardens Are For People.*
ECKBO. *The Art of Home Landscaping.*
ENGEL. *Japanese Gardens Today.*
ORTLOFF *and* RAYMORE. *The Book of Landscape Design.*
SIMONDS. *Landscape Architecture.*
SUNSET. *Landscaping for Modern Living.*
———. *The Sunset Garden Series.*

Instructional Aids

Models of residential and industrial sites
2" x 2" color slides
Campus gardens and plant materials
Various kinds of plans prepared by professional designers and landscape architects

MUNICIPAL ARBORICULTURE

Hours Required

Class, 2; Laboratory, 4

Course Description

A study of the organization and functioning of tree departments within the structure of various governmental units with emphasis on local and State conditions.

Emphasis is placed on the details of forming and developing a municipal tree department for safe and efficient operation; and outlining the competencies, duties, responsibilities, and relationships of the people involved.

Major Divisions

	Class Hours
I. Municipal Arboriculture	3
II. Tree Planning	10
III. Planting	4
IV. Street Tree Management	15
Total	32

Units of Instruction

- I. Municipal Arboriculture
  - A. Municipality—a political unit
    - 1. State
      - a. Parks
      - b. Turnpike authorities
      - c. Highway departments (public works)
      - d. Universities and hospitals
    - 2. County
      - a. Parks
      - b. Parkways
      - c. Highways
    - 3. City
      - a. Parks
      - b. Highways
    - 4. Town and township
    - 5. Incorporated village
  - B. Administration
    - 1. Public works
    - 2. Highway commissioners
    - 3. Parks commissioners
    - 4. City "forester"
    - 5. Shade tree commissions
  - C. Jurisdiction
    - 1. Street trees
    - 2. Parks and parkways
    - 3. Other public properties
  - D. Responsibility
    - 1. Public safety
    - 2. Inspectors and supervisors
    - 3. Maintenance of existing trees
    - 4. Planning
    - 5. Planting
  - E. Organization of people and their duties
- II. Tree Planning
  - A. Role of shade tree commission
    - 1. Formulate policy
    - 2. Draw up local ordinances
    - 3. Direct planning
    - 4. Advise administration
  - B. Survey of existing street trees
    - 1. Use of street map
    - 2. Essential data
      - a. Property designation
      - b. Locate each tree
      - c. Identify kind
      - d. Size and caliper
      - e. Condition
      - f. Recommended action
  - C. Master plan
    - 1. Main traffic arteries
    - 2. Wide parkway
    - 3. Residential
    - 4. Malls
  - D. Tree placement
    - 1. Lawn side
    - 2. Tree lawn
    - 3. Street lights
    - 4. Intersections
    - 5. Spacing of trees
    - 6. Overhead wires
  - E. Variety in planting
    - 1. Formal or informal
    - 2. Epidemic diseases
  - F. Trees in plant boxes
  - G. Selections
    - 1. Ecological adaptability
      - a. Species
      - b. Varieties
      - c. Clones
      - d. Cultivars
    - 2. Plant factors
      - a. Environmental suitability
      - b. Tree form
        - (1) Fastigiate
        - (2) Columnar
        - (3) Conical

- (4) Oval
- (5) Globe
- (6) Spreading
- (7) Vase
- c. Growth
  - (1) Rate
  - (2) Mature size
  - (3) Form
- d. Foliage density
- e. Features
  - (1) Flower color
  - (2) Foliage color
  - (3) Texture
- f. Pests

H. Recommended varieties
- 1. By plant form
- 2. By mature size
  - a. Tall—over 40′
  - b. Medium—30′–40′
  - c. Small—30′

III. Planting
- A. Grading of nursery grown trees
- B. Bare root, or ball and burlap planting
- C. Planting specifications
  - 1. Size of tree pit
  - 2. Drainage
  - 3. Topsoil
  - 4. Staking and protection
  - 5. Pruning
  - 6. Watering and maintenance
- D. Large tree moving
  - 1. Preparation
    - a. Site
    - b. Root pruning and invigoration
  - 2. Equipment
  - 3. Size of root ball
  - 4. Planting
  - 5. Protection after planting
    - a. Guying
    - b. Pruning
    - c. Wrapping
    - d. Antidesiccants
    - e. Liquid feeding
    - f. Irrigation

IV. Street Tree Management
- A. Planned program
  - 1. Survey
  - 2. Record keeping
  - 3. Budget for operations
- B. Rehabilitation of established trees
  - 1. Pruning
  - 2. Removals
  - 3. Replacements
- C. Maintenance
  - 1. Annual inspections
  - 2. Complaint procedures
  - 3. Pruning standards
  - 4. Contract specifications
  - 5. Spraying and misting programs
- D. Equipment
  - 1. Trucks
  - 2. Sprayers and mist blowers
  - 3. Cranes
  - 4. Loaders, excavators, and trenchers
  - 5. Tree mover
  - 6. Stump grinder
  - 7. Brush chipper
  - 8. Chain saws
  - 9. Vacumn sweeper
  - 10. Digging tools
  - 11. Cutting tools
  - 12. Winch and pulley blocks
  - 13. Hand repair tools and supplies
  - 14. Diagnostic tools
- E. Personnel policies, titles, qualifications, and duties
  - 1. Arboriculturist
  - 2. Horticulturist
  - 3. Director
  - 4. Superintendent
  - 5. Forester
  - 6. Foreman
  - 7. Pruner
  - 8. Others

Recommended Laboratory Projects—64 hours

- I. Study the operation of an arboretum (4 hours).
- II. Prepare shade tree surveys (8 hours).
- III. Write a shade tree ordinance (4 hours).
- IV. Take field trips to observe the operation of tree departments (12 hours).
- V. Write specifications for a planting contract (4 hours).
- VI. Write specifications for a tree removal contract (4 hours).
- VII. Execute a planting project (8 hours).
- VIII. Prepare a budget for a tree department (4 hours).
- IX. Prepare an operating budget for a municipality (8 hours).

X. Prepare a tree department long-range master plan using information from previous laboratories (8 hours).

Texts and References

Texts on municipal arboriculture do not exist, but many books used in other courses will prove useful.

FENSKA. *Tree Experts Manual.*

U.S. Department of Agriculture. *Trees. The Yearbook of Agriculture, 1949.*

Instructional Aids

Village, city, town, county and commission rules, regulations, and ordinances

NURSERY OPERATION I

Hours Required

Class, 1; Laboratory, 6

Course Description

An introductory course in nursery operations and management which covers many operational details of nursery plant production. The course is designed primarily as a laboratory course to acquaint the students with the diversity of nursery plant production, equipment, and operation. Nursery operation principles are considered in the class units of instruction and the laboratory work emphasizes performing nursery operations and work. Special attention is given to teaching the student to recognize the importance of efficient work habits by implementing operational time studies and analyzing the effectiveness of orderly, planned, timely procedures in nursery operations.

Major Divisions

		Class Hours
I.	Soil Preparations	1
II.	Planting Operations	2
III.	Root Pruning and Transplanting	2
IV.	Fertilization Treatments	1
V.	Herbicides and Allied Treatments	2
VI.	Pest Control	2
VII.	Container Production	2
VIII.	Nursery Plant Top Management	2
IX.	Construction of Special Structures	2
	Total	16

Units of Instruction

I. Soil Preparations
  A. Fitting the soil for planting
    1. Seed beds
    2. Transplant beds
    3. Production
  B. Incorporation of soil amendments
    1. Manure
    2. Green manures
    3. Peat
    4. Organic mulches
  C. Equipment
    1. Plows, harrows, subsoilers
    2. Rotary cultivator
    3. Soil shredders

II. Planting Operations
  A. Hand and small tools
    1. Dibble compared to planting boards
    2. Planting lines and spade
  B. Mechanical planters
    1. Field work
    2. Container growing

III. Root Pruning and Transplanting
  A. Hand and spade
  B. Power equipment

IV. Fertilization Treatments
  A. Hand methods
  B. Machine drill
  C. Machine scatter pattern

V. Herbicides and Allied Treatments
  A. Equipment for application
  B. Gas
  C. Liquid
  D. Pellets and powders

VI. Pest Control
  A. Equipment for application
  B. Hydraulic
  C. Mist
  D. Dust
  E. Pellets

VII. Container Production
  A. Equipment facilities
    1. Small-scale operation
    2. Large-scale operation
  B. Labor and timesaving devices and techniques
    1. Media blenders
    2. Container fillers
    3. Planters
    4. Operational organization

VIII. Nursery Plant Top Management
  A. Pinching
  B. Shearing
  C. Pruning

IX. Construction of Special Structures
  A. Shade structure
    1. Lath-shade frames
    2. Lath-shade house
    3. Woven plastic fabric structures
  B. Temperature control structure, plastic film covered

    1. Cold frames
    2. Hot beds
    3. Pipe-frame plastic film greenhouse
- C. Winter protection structures
    1. Deep frame
    2. Plastic film structures
- D. Plant storage
    1. Containers used
    2. Environmental control

Recommended Laboratory Projects—96 hours

I. Prepare seed beds for planting (12 hours).
II. Plant seed beds (12 hours).
III. Prepare transplant beds (12 hours).
IV. Transplant to beds (12 hours).
V. Grow plants in containers (6 hours).
VI. Root-prune a selection of plants (6 hours).
VII. Fertilize plants as indicated by instructor (6 hours).
VIII. Study equipment and apply herbicides (12 hours).
IX. Control nursery plants by pinching, shearing and pruning (12 hours).
X. Prepare and use plant growing structures (6 hours).

Texts and References

American Association of Nurserymen. *American Standard for Nursery Stock.*

California Agricultural Extension Service Manual No. 23. *The U.C. System-Container Grown Plants.*

Rainbird Sprinkler Manufacturing Corp. *Sprinkler Irrigation Handbook.*

U.S. Department of Agriculture. Agricultural Handbook No. 110. *Forest Nursery Practice.*

———. Miscellaneous Publication No. 654. *Woody Plant Seed Manual.*

Instructional Aids

Nursery area—2 or more acres—productive soil.

Propagation area:
1. Propagation house minimum area 500 square feet
2. Cold frames, hot beds, pit frames
3. Shade structures
4. Winter protection structures

Equipment and storage building, minimum 1,000 square feet.

Heated laboratory work area, minimum 1,000 square feet.

NURSERY OPERATION II

Hours Required

Class, 3; Laboratory, 3

Course Description

A continuation of Nursery Operation I, emphasizing the theory and practices necessary to produce profitable nursery stock. Cultivating and maintaining a productive nursery tract receive first consideration. Crop and land rotations are carefully studied to show the importance of the length of rotation time, soil type, organic matter retention, and soil compaction forces. Rates of spread of plant roots and tops are studied as they affect crop maturity and planting distances.

Major Divisions

	Class Hours
I. Soil Types and Plant Adaptability	3
II. Correcting Soil Tilth	3
III. Green Manure and Sod-Crop Scheduling	3
IV. Straight Row, Block Planting, and Contour Planting	6
V. Plant Grouping for Production Purposes	12
VI. Irrigation	3
VII. Special Plant Handling—Plant Grouping	18
Total	48

Units of Instruction

I. Soil Types and Plant Adaptability
  A. Sand loams
    1. Coarse-rooted species
    2. Bare-root handling
  B. Medium loams
    1. Fibrous-rooted species
    2. Ball and burlap or root-ball handling
  C. Examination of plant lists for:
    1. Soil preferences
    2. Preparation of plant lists
      a. Bare-root handling
      b. Root-ball handling—Plant grouping

II. Correcting Soil Tilth
  A. Values of soil structure and organic matter
  B. *p*H values and lime corrections
  C. Organic matter additions

III. Green Manure and Sod-Crop Scheduling
  A. Effect of soil type on choice of organic matter (OM) producers
  B. Retention of OM, based on type of OM producers
  C. Land preparation and time schedules for
    1. Sowing
    2. Fertilization
    3. Plow down
    4. Planting nursery crop

IV. Straight Row, Block Planting, and Contour Planting
  A. Straight row
    1. Advantages
    2. Disadvantages
  B. Contour
    1. Advantages
    2. Disadvantages
    3. Contour layout and construction

V. Plant Grouping for Production Purposes
  A. Establishing plant production cycles
    1. Transplant bed (TB)
    2. Close liners (CL)
    3. Spaced liners (SL)
    4. Length of time in position
  B. Developing code designations for planting purposes

VI. Irrigation
  A. Values and necessity
  B. Rates and frequency of applications
  C. Volume required
  D. Source and mode of supply
  E. Costs and values

VII. Special Plant Handling—Plant Grouping
  A. Root pruning
  B. Top pruning
  C. Fertilization rates and kinds
  D. Mulches
  E. Winter protection
  F. Irrigation

Recommended Laboratory Projects—48 hours

The laboratory work for this phase of nursery operations study is best taught by visitations to commercial nurseries. The most effective teaching tool for the course would be to conduct at least eight intensified studies in commercial nurseries. Nurseries—large and small—retail and wholesale production and sales, and specialities nurseries should be visited. A special form should be devised for the visits. Student reports and discussion should be developed from the visitations and special forms.

I. Visit 10 commercial nurseries (30 hours).

II. Prepare a plot of land for nursery plants (6 hours).

III. Set plants in the nursery (3 hours).

IV. Cultivate, weed, provide organic matter, and fertilize nursery plants (6 hours).

V. Prepare a map of one nursery (3 hours).

Texts and References

American Association of Nurserymen. *American Standard for Nursery Stock.*

California Agricultural Extension Service Manual 23. *The U. C. System-Container Grown Plants.*

Rainbird Sprinkler Manufacturing Corporation. *Sprinkler Irrigation Handbook.*

U.S. Department of Agriculture. Agricultural Handbook No. 110. *Forest Nursery Practice.*

———. Miscellaneous Publication No. 654. *Woody Plant Seed Manual.*

Instructional Aids

The school or college nursery
Plant growing structures
Nurseries in the area

NURSERY OPERATION III

Hours Required

Class, 2; Laboratory, 3

Course Description

This final course in the series on nursery production draws upon the knowledge gained in the two preceding courses. It provides study of the correlation of production schedules with nursery land use. Factors affecting choice and quantities of stock to be grown, as well as developing cost finding and price establishing, are studied.

Major Divisions

	Class Hours
I. Factors Affecting Choice of Nursery Stock	4
II. Establishing Percentages of Nursery Stock	3
III. Adapting Crops to Nursery Site	3
IV. Planning Nursery Layout	6
V. Planning Facilities	6
VI. Developing Cost-Finding Systems	5
VII. Drawing Scale Plans for Various Types of Nurseries	5
Total	32

Units of Instruction

I. Factors Affecting Choice of Nursery Stock
  A. Soil and climatic conditions
  B. Popular demand
  C. Speed of plant development
  D. Nearness to market
  E. Land values
  F. Grower's preference
  G. Advantage and disadvantage of specialization growing

II. Establishing Percentages of Nursery Stock
  A. How and where plants are used in the landscape
  B. Volume in production
  C. Quantities sold at various ages and/or sizes

III. Adapting Crops to Nursery Site
  A. Plant adaptability relative to soil type
  B. Air drainage and frost pockets
  C. Winter protection
  D. Water requirement and availability

IV. Planning Nursery Layout
  A. Block and section size
  B. Distance of planting
  C. Length of time in rotation
  D. Soil-building program in rotation
  E. Establishing location of nursery roads

V. Planning Facilities
  A. Location
    1. Availability to markets
    2. Value of land
    3. Quality of land
  B. Size
    1. Beds—frames, shade house, propagation house, winter storage
    2. Storage buildings
      a. Size
      b. Kind of storage (controlled temperature).
      c. Storage time required
    3. Water source
    4. Sales area
    5. Office

VI. Developing Cost-Finding Systems
  A. Developing time record charts on specific crop production operations
  B. Establishing hidden costs not contributed to specific crops
  C. Establishing ratios between A and B
  D. Establishing a cost production formula

VII. Drawing Scale Plans for Various Types of Nurseries
  A. Draw scale plans of nursery to show:
    1. Sections and blocks
    2. Rotation schedules
    3. Row direction
    4. Roads
    5. Location and size of facilities
  B. Draw scale plans of special facilities such as:
    1. Propagation house and frames
    2. Winter storage structures
    3. Container growing facilities
    4. Special storage areas
    5. Sales area and buildings
    6. Office area

Recommended Laboratory Projects—48 hours

I. Choose stock to be grown in six different local situations (6 hours).

II. Plan layouts for the six situations (12 hours).

III. Plan facilities for the above or for other local nurseries to be established (12 hours).

IV. Develop a cost-finding system for an existing nursery (3 hours).

V. Develop a cost-finding system for a nursery to be established (3 hours).

VI. Draw scale plans of nursery (6 hours).

VII. Draw scale plans of special facilities (6 hours).

Texts and References

American Association of Nurserymen. *American Standard for Nursery Stock.*

California Agricultural Extension Service Manual 23. *The U. C. System-Container Grown Plants.*

Rainbird Sprinkler Manufacturing Corporation. *Sprinkler Irrigation Handbook.*

U.S. Department of Agriculture. Agricultural Handbook No. 110. *Forest Nursery Practice.*

———. Miscellaneous Publication No. 654. *Woody Plant Seed Manual.*

Instructional Aids

Nursery areas
Catalogs
Charts and slides
Examples of post sheets from nurseries

PLANT PROPAGATION

Hours Required

Class, 3; Laboratory, 3

Course Description

A course designed to teach the principles, methods, techniques, and facilities used by commercial nurserymen in plant propagation.

The course emphasizes the many methods used in the propagation of commercial plants, and demonstrates the need for planning and resourcefulness in plant propagation. The class and laboratory work presented should motivate the student to learn by testing new ideas which have been developed and reported on by the International Plant Propagators Society. This course should be presented in the fall term of the second year.

Major Divisions

	Class Hours
I. Seedage	9
II. Cuttage	24
III. Graftage	12
IV. Division, Layerage, and other methods	3
Total	48

Units of Instruction

- I. Seedage
  - A. Seed sources
    - 1. Seed plants
    - 2. Time to harvest
    - 3. Methods of harvesting
    - 4. Cleaning and drying
    - 5. Storage
  - B. Seed treatments
    - 1. Hard-coat seed (external dormancy)
    - 2. Internal seed dormancy
    - 3. Direct seed sowing
    - 4. Stratification
    - 5. One- and 2-year seeds
  - C. Seed sowing
    - 1. Time in relation to optimum development
    - 2. Broadcast and drill seeding
    - 3. Cultural details
      - a. Media
      - b. Rate, based on viable seed and length of time to stand
      - c. Depth of planting
      - d. Post germination care (nutrients, water and light control)
- II. Cuttage
  - A. Kinds of cuttings
    - 1. Soft wood, green wood, and ripe wood
    - 2. Species favored by kind of cutting (condition of tissues)
    - 3. Time of year for favorable results
  - B. Special details
    - 1. Hormones—rooting chemicals
    - 2. Wounding
    - 3. Media
    - 4. Cutting turger controls (humidity control)
      - a. Hand syringe
      - b. Misting system and controls
      - c. Vapor-proof chamber
    - 5. Temperature requirements and control
    - 6. Light factors in rooting
    - 7. Recognition of dormant or active buds in relation to operational details
- III. Graftage
  - A. Kinds of grafts
    - 1. Scion
      - a. Advantages
      - b. Time of operation
    - 2. Budding
      - a. Advantages
      - b. Time of operation
    - 3. Species and genera preference
  - B. Mechanics of grafting
    - 1. Understock
      - a. Production
      - b. Processing
    - 2. Scions and buds
      - a. Selection
      - b. Collection and storage
    - 3. Kinds of cuts
      - a. Scion, whip-whip, and tongue-side-veneer
      - b. Budding and T-patch
    - 4. After-care treatments
      - a. Open exposure
      - b. Closed case
      - c. Plunged in moist media
- IV. Division, Layerage, and Other Methods
  - A. General and species favored
  - B. Time of year practiced
  - C. Techniques of operation

D. Special detail and notations

Recommended Laboratory Projects—48 hours

I. Construct and prepare a seed bed (3 hours).

II. Gather early maturing seed (3 hours).

III. Clean seed and make germination test (3 hours).

IV. Treat seeds with hard-seed coats; file, H_2SO_4 (3 hours).

V. Stratify seed and work on seeding formulas (3 hours).

VI. Sow seed in the seed bed (3 hours).

VII. Gather late maturing seed (3 hours).

VIII. Gather and make broadleaf cuttings (3 hours).

IX. Treat broadleaf cutting with a growth agent at various concentrations and preparations of same (3 hours).

X. Gather and make narrowleaf cuttings (3 hours).

XI. Gather and make hardwood cuttings (3 hours).

XII. Gather and make softwood cuttings (3 hours).

XIII. Gather and make leaf, divided leaf, bud and leaf bud cuttings, and practice layering (3 hours).

XIV. Seed sowing of broadleaf and narrowleaf evergreens in flats (3 hours).

XV. Use various types of propagation of bulbs, rhizomes, stolons, and root cuttings (3 hours).

XVI. Practice grafting and budding (3 hours).

Texts and References

HARTMAN *and* KESTER. *Plant Propagation Principles and Practices.*

———. Miscellaneous Publication No. 654. *Woody Plant Seed Manual.* 1948.

PLANTING PLANS I

Hours Required

Class, 1; Laboratory, 3

Course Description

A course for students of Nursery Operation designed to teach the principles of landscape design and the technical aspects of planning and constructing landscape projects related to a nursery.

Class instruction emphasizes the theory and principles of design and planning, teaching how the effective use of plant material adds to the attractiveness of a building, and the usefulness of its surroundings. The rules and maxims for effective property development are discussed in detail. Use of color slides and other visual aids help to illustrate the results of proper planning by showing properties before and after landscape design and construction. In addition, visual aids should be selected to demonstrate good and bad landscape treatment.

In the laboratory basic drawing and drafting procedures are reviewed. Students are taught to make quick sketches which can be used commercially for promoting the sale of nursery products. The skills and abilities of students in the use of drawing instruments and materials are further developed in the creation of drawings in plan, elevation and one-point perspective. Hypothetical homes and properties are used as the basis for the work in this course.

Major Divisions

	Class Hours
I. Present Day Landscape Trends	1
II. Objectives of Proper Planning	1
III. Theory of Landscape Design	1
IV. Principles of Design	2
V. Principles of Landscape Composition	2
VI. Site Development	2
VII. Property Development	4
VIII. Public Area Development	3
Total	16

Units of Instruction

I. Present Day Landscape Trends
  A. Simplified plantings
    1. Ground covers
    2. Trees
  B. Outdoor living
  C. Picture windows
  D. Contemporary architecture
  E. Climate control

II. Objectives of Proper Planning
  A. Beauty
  B. Utility
  C. Reasons for planning
    1. Economy of space
    2. Charm and utility
    3. Increased enjoyment of outdoors
    4. Expression of taste
    5. Expression of personalities

III. Theory of Landscape Design
  A. Sensation
  B. Deception
  C. Participation
    1. Imagination
    2. Activity

IV. Principles of Design
  A. Focalization
    1. Center of interest
    2. Gradation
    3. Sequence
  B. Methods of achieving unity
    1. Control of design
    2. Line
    3. Pattern
  C. Balance
    1. Symmetrical
    2. Asymmetrical
    3. Weight
    4. Volume
  D. Scale
    1. Definition
    2. Methods of achievement
  E. Simplicity
    1. Control variety of plants
    2. Restraint

V. Principles of Landscape Composition
  A. Transition
  B. Opposition
  C. Repetition
  D. Rhythm
  E. Harmony
  F. Color
  G. Texture

VI. Site Development
  A. Selection of property
    1. Shape of lot
    2. Topography
      a. Flat
        (1) Easy to develop
        (2) Economical
      b. Varied
        (1) Interest
        (2) Cost
    3. Natural features
      a. Plants
      b. Water
      c. Soil
      d. Rock
  B. Other considerations
    1. Economics
    2. Social
    3. Accessibility
    4. Zoning
      a. Restrictions
      b. Ordinances
    5. Size
      a. Cost for development
      b. Development potential

VII. Property Development
  A. Division for objective development
    1. Public area
      a. Entrance development
      b. Introduction to property
    2. Private area
      a. Outdoor living
      b. Privacy
      c. Active recreation (play areas, exercise)
      d. Passive recreation (study, rest, eating)
    3. Service area—utilitarian needs
      a. Tools
      b. Supplies
      c. Refuse storage
      d. Laundry drying
  B. Proportioning of areas
    1. Golden mean—5-7 ratio
    2. Size
    3. Shape
  C. Circulation
    1. Walks
    2. Steps
    3. Ramps
    4. Vistas

VIII. Public Area Development
  A. Entrance development
  B. Open to public
    1. Conventional treatment
    2. Property value
  C. Enclosed
    1. Eliminate dust and dirt
    2. Protect house from noise
    3. Privacy—picture windows
    4. Confusion elimination
    5. Land utilization
  D. Approach to building
    1. Walks
      a. Design
      b. Materials
      c. Justify curves
      d. Materials
    2. Driveway
      a. Design
      b. Materials
      c. Turncourts
  E. Foundation planting
    1. Value and logic
    2. Objectives in selection and placement of plants
      a. Transition of buildings and grounds
      b. Emphasize architectural details of building
      c. Conceal objectionable foundation construction
      d. Overall beauty of entrance development
    3. Plants placed to achieve principles of landscape design
      a. Focalization
      b. Unity
      c. Balance
      d. Scale
      e. Simplicity

Recommended Laboratory Projects

I. Make a lettering plate. Practice use of T-square, triangles, architect's scale ruler, engineer's scale ruler, compass, divider, and lettering guide. Emphasis is placed on use of guidelines rather than style of lettering (3 hours).

II. Make a plant indication and symbol plate. Practice drawing trees, shrubs and evergreens, singly and in groups, in plan and elevation (6 hours).

III. Prepare a plan and elevation drawing. Learn procedure by using tracing paper overlays on carefully scaled and prepared base drawing. Prepare a final drawing of small home in plan and elevation. These can be hypothetical, taken from architect's or builder's drawing (3 hours).

IV. Prepare a complete planting plan for entrance development of small home from previous problems, using the following outline as a basis (12 hours).
  A. Required:
    1. One drawing showing elevation of building with proposed plant in elevation
    2. One drawing showing plan of building facade with proposed planting in plan
  B. Drawings to include:
    1. Title (with necessary information)
    2. Plant key or plant names (with scientific name) directly on plan
    3. Scale of drawing
    4. Orientation
  C. Consider:
    1. Existing garages, walks, cesspools and features
    2. Practical approach to building via driveway and walk or walks

V. As another requirement, draw a one-point perspective of Problem IV's entrance development solution, using the grid and perspective method (9 hours).

VI. Prepare complete planting plans for an entrance development. The example can be taken from an architect's drawings, incorporating the following drawings (15 hours):
  A. Elevation of building with proposed planting in elevation
  B. Plan of building facade with proposed planting in plan
  C. One-point perspective drawing of elevation-plan solution

Texts and References

BUSH-BROWN. *America's Garden Book.*
SUNSET. *Landscaping for Modern Living.*

Instructional Aids

2" x 2" color slides
Campus gardens and plantings
Community parks
Community gardens
Sample plans prepared by landscape nurserymen, landscape architects and site planners

PLANTING PLANS II

Hours Required

Class, 1; Laboratory, 6

Course Description

This course is a continuation of Planting Plans I, with emphasis on private area development and the more difficult problems of planting design.

Class instruction focuses on plant groupings and their use in relation to ecological and climatic requirements and design effectiveness. Cost estimation of landscape projects is stressed to teach students how to find practical as well as aesthetic solutions to assigned problems.

In the laboratory hypothetical problems are continued with considerable emphasis on design principles. Drawing skills and abilities are further developed to enable the students to plan and draw two-point perspectives of buildings and proposed plantings. Civic areas and faculty home sites are used for advanced problems.

Major Divisions

		Class Hours
I.	Private Area Development	3
II.	Service Area Development	1
III.	Planting Design	3
IV.	Cost Estimating	2
V.	Water in Landscape Design	2
VI.	Site Preparation	1
VII.	Industrial and Municipal Properties	1
VIII.	Structures in Landscape Design	3
	Total	16

Units of Instruction

I. Private Area Development
  A. Purpose of development
    1. Outdoor living
    2. Garden or ornamental
  B. Means of development
    1. Axis line
      a. Backbone and skeleton
      b. Reference lines
      c. No construction on line
    2. View
      a. Picture window
      b. Control
      c. Enframement
  C. Terraces and patios
    1. Transition from indoor to outdoor living
    2. Location
      a. Accessibility
      b. Degree of privacy
    3. Surface
      a. Paved
      b. Unpaved
    4. Size
    5. Protection
      a. Sun
      b. Shade
      c. Wind
      d. Heat
      e. Sound
      f. Visibility
    6. Materials
      a. Brick
      b. Flagstone
      c. Concrete
      d. Asphalt
      e. Crushed stone
      f. Pebbles
      g. Turf
      h. Tanbark
  D. Type of development
    1. Formal
    2. Informal
    3. Natural
    4. Geometric
    5. Contemporary
  E. Enclosure
    1. Practical considerations
      a. Privacy
      b. Seclusion
      c. Protection from elements
    2. Aesthetic considerations
      a. Background
      b. Control views
    3. Materials
      a. Fences
      b. Walls
      c. Plants
      d. Hedges
  F. Spaciousness
    1. Simplicity
    2. Center areas open
    3. Scale relationship
    4. Proportioning planted areas to open areas

- G. Interest
    - 1. Subdivision
    - 2. Topography change
    - 3. Level change
    - 4. Terracing
    - 5. Mystery
- H. Livability
    - 1. Passive recreation
    - 2. Active recreation
    - 3. Amusement
    - 4. Study
    - 5. Animation
- I. Imagination
    - 1. Originality
        - a. Details
        - b. Materials
    - 2. Express personalities of home owners
    - 3. Avoid novelties and freakish details
- J. Traffic circulation
    - 1. Paths
    - 2. Walks
    - 3. Gates
    - 4. Open lawn areas

II. Service Area Development

- A. Purpose
    - 1. Laundry drying
    - 2. Compost
    - 3. Material storage
    - 4. Tool storage
    - 5. Propagation area
    - 6. Vegetable garden
    - 7. Cut flower area
    - 8. Deliveries
- B. Size
- C. Location
    - 1. Accessibility
    - 2. Amount of traffic

III. Planting Design

- A. Effect of deciduous material
    - 1. Great variety
    - 2. Easy availability
    - 3. Seasonal changes
        - a. Color
        - b. Texture
        - c. Foliage
        - d. Flower
        - e. Fruit
    - 4. Informal outline and shapes
    - 5. Effects of shearing
        - a. Topiary
        - b. Hedges
        - c. Accent
- B. Effects of conifers
    - 1. Constant effects
        - a. Color year-round
        - b. Foliage year-round
        - c. Form
    - 2. Size
        - a. Forest varieties
        - b. Horticultural varieties
    - 3. Texture
- C. Effects of broadleafed plants
    - 1. Happy medium
    - 2. Form and size
    - 3. Color year-round
    - 4. Foliage year-round
    - 5. Flower interest
    - 6. Informal
    - 7. Bold texture
    - 8. Mass
- D. Trees
    - 1. Control views
        - a. Frame house
        - b. Frame features
        - c. Privacy
    - 2. Shade
        - a. Protect
        - b. Shadow
        - c. Soften architectural lines
    - 3. Effects of size
        - a. Large tree dwarfs
        - b. Small tree exaggerates size of surrounding masses
        - c. Perspective
- E. Ecology
    - 1. Compatibility
    - 2. Climatic area

IV. Cost Estimating

- A. Methods of charging
    - 1. Contract
    - 2. Cost plus
- B. Contract
    - 1. Identification of client
    - 2. Services to be performed
    - 3. Method of payment
    - 4. Items supplied and extra work
    - 5. Supervision
    - 6. Duration
    - 7. Cancellation provisions
- C. Factors considered in estimating cost of landscape project
    - 1. Client's needs
        - a. Variety of plans
        - b. Selection of final plans

2. Type of work required
    a. Labor
    b. Constructing
    c. Planting
    d. Rough work
    e. Finish work
    f. Details involved
3. Size of project
    a. Small
    b. Large
    c. Private home
    d. Commercial
    e. Public
4. Equipment involved
    a. Trucks
    b. Tractors
    c. Bulldozer
    d. Rototiller
    e. Power saw
    f. Other types
5. Local conditions
    a. Soil
    b. Custom home
    c. Development home
    d. Restrictions and ordinances

D. Basis for estimating
    1. Indirect costs (overhead)
        a. Compensation
        b. Taxes
        c. Hospitalization
        d. Insurance
        e. Office maintenance
            (1) Furnishing and equipment
            (2) Telephones
            (3) Electricity
            (4) Fuel
            (5) Water
            (6) Salaries—clerical and management
            (7) Custodial services
            (8) Fees—attorney and accountant
            (9) Supplies
        f. Power equipment and hand tools
        g. Tools
        h. Insurance
            (1) Liability
            (2) General
        i. Specifications
        j. Estimating
        k. Selling
        l. Financing and collecting
    2. Direct costs
        a. Materials
            (1) Plants
            (2) Peat moss
            (3) Fertilizer
            (4) Stakes
            (5) Wire
            (6) Wrapping
        b. Labor
            (1) Planting
            (2) Clean-up
    3. Profit

V. Water in Landscape Design
    A. History
    B. Practical and psychological effects
        1. Cooling
        2. Sound
        3. Reflection
        4. Movement
    C. Swimming pools
        1. Design
        2. Construction
    D. Water as landscape feature
        1. Formal pool
        2. Informal pool
        3. Naturalistic pond
        4. Stream
    E. Sources
        1. Natural
        2. Artificial
    F. Drainage

VI. Site Preparation
    A. Grading plan
        1. Existing contours
        2. Proposed contours
    B. Rough grading
        1. Installation of utilities
        2. Cut
        3. Fill
        4. From building
    C. Control of steep slopes
        1. Terracing
        2. Rip rap
        3. Retaining walls
        4. Plants
    D. Drainage
        1. Natural
            a. Surface
            b. Swales
        2. Controlled
            a. Catch basins
            b. Dry wells
            c. Tile lines

- d. Leaching fields

VII. Industrial and Municipal Properties
- A. Planning
- B. Zoning
- C. Types
  - 1. Schools
  - 2. Civic buildings
  - 3. Civic centers
    - a. Town square
    - b. Monuments
  - 4. Housing
    - a. Public
    - b. Private
  - 5. Industrial
    - a. Factories
    - b. Offices
  - 6. Shopping centers
  - 7. Parks
    - a. Community
    - b. Regional or county
    - c. State and Federal

VIII. Structures in Landscape Design
- A. Need and reasons for use
  - 1. Dominate landscape
  - 2. Subordinate landscape
- B. Steps
  - 1. Olmstead rule
    - a. Proportion riser to tread
    - b. Smaller risers outdoors
    - c. Risers 4–6 inches
    - d. Treads 14–20 inches
  - 2. Materials
  - 3. Construction
- C. Benches
  - 1. Stone
  - 2. Concrete
  - 3. Wood
    - a. With back support
    - b. Without back support
  - 4. Brick
- D. Alpine units
  - 1. Rock stratification
  - 2. Rock formation
  - 3. Water
- E. Free-standing units
  - 1. Statues
  - 2. Sundials
  - 3. Gazing globes
  - 4. Bird baths
  - 5. Bird feeders
- F. Accessory buildings
  - 1. Garden house
  - 2. Play house
  - 3. Summer house
  - 4. Tool shed
  - 5. Dressing rooms

Recommended Laboratory Projects—96 hours

I. Prepare a complete planting plan for a private area and service area facilities for house used in laboratory project IV—first semester (18 hours).
- A. Required Work:
  - 1. Prepare a presentation and planting plan of entire property and improve entrance development planting for project IV
  - 2. Prepare a plant key, listing scientific name, size and quantity
- B. Consider and Include:
  - 1. Privacy and seclusion
  - 2. Patio or terrace, or both
  - 3. Facilities for service of home and garden
  - 4. Special interests in the landscape

II. Prepare a two-point perspective drawing of entire property with structures and plantings (18 hours).

III. Prepare a complete planting plan for a private area and service area facilities for residential property in Project VI—first semester (24 hours).
- A. Prepare a presentation and planting plan of entire property and improve entrance development planting for Project VI
- B. Prepare a plant key on plan listing scientific name, size, and quantity
- C. Prepare a one-point perspective sketch of feature or small area
- D. Prepare a two-point perspective of entire property

IV. Prepare a complete planting plan for development of a residential property of 20,000 to 30,000 square feet. (The property of a faculty member can be used.) Requirements of problem are to be determined by client through interview (18 hours).
- A. Prepare a one-point perspective of house and entrance development
- B. Prepare a presentation and planting plan of property to satisfy wishes of client

   - C. Prepare a cost estimate for construction over a 3-year period $3,000 to $4,000, considering the use of existing plants and the expressed desire of client
- V. Complete site development and planting plan for church, school, or commercial building (9 hours).
   - A. Prepare a presentation and planting plan in color (pencil)
   - B. Draw a system of roads and walks for approach and service of building
   - C. Plan and draw suggested parking facilities
   - D. Prepare a plant key
- VI. The student must present measurements, photographs, and factual requirements of a residential *or* commercial property as a final term project. The method of presentation may be chosen by the student but must be complete and informative (9 hours).

Texts and References

BUSH-BROWN. *America's Garden Book.*

BUTLER. *Recreation Areas, Their Design and Equipment.*

CHURCH. *Gardens Are For People.*

ECKBO. *The Art of Home Landscaping.*

ORTLOFF *and* RAYMORE. *The Book of Landscape Design.*

SUNSET. *Garden and Patio Building Book.*

———. *Landscaping for Modern Living.*

Instructional Aids

2" x 2" slides
Campus gardens
Field trips to local plantings
Examples of plans

SHADE TREE PROBLEMS

Hours Required

Class, 2; Laboratory, 3

Course Description

This course provides an elementary understanding of why some shade trees do not thrive. Symptoms of abnormality are analyzed and the required steps to correct the condition are studied. Preventive and remedial measures are emphasized and analytic perception and diagnostic skills are developed. Some competence is developed in the handling and application of pesticides.

Major Divisions

	Class Hours
I. Shade Tree Ecology	12
II. Shade Tree Ills	12
III. Pesticide Application	8
Total	32

Units of Instruction

I. Shade Tree Ecology
  A. Ecology of roots
    1. Absorption—root hairs
    2. Anchorage
    3. Food storage
    4. Growth and adventitious growth
    5. Aeration and root growth
    6. Roots and transplanting
  B. Ecology of stems
    1. Foliage display
    2. Conductive tissues
    3. Mechanical tissues
    4. Protective tissues
    5. Stem habits
      a. Tropical
      b. Evergreen—sclerophylls
        (1) Broad-leaved
        (2) Needle-leaved
    6. Storage tissues
    7. Growth
      a. Elongation
      b. Diameter increase
    8. Twig characteristics
  C. Ecology of leaves.
    1. Structure
    2. Water-saving features
    3. Functioning
      a. Respiration
      b. Transpiration
      c. Photosynthesis
    4. Abscission (leaf fall)
    5. Coloration
  D. Symbiosis
    1. Disjunctive symbiosis
      a. Social
      b. Nutritive
    2. Conjunctive symbiosis
      a. Social
      b. Nutritive
    3. Examples of symbiosis
      a. Pollination
      b. Epiphytism
      c. Parasitism
      d. Mycorrhizae
      e. Galls
      f. Lichens
        (1) Endotrophic
        (2) Ectotrophic
  E. Physical environmental factors
    1. Gravity
    2. Light
    3. Heat
      a. Temperature range
      b. Soil temperature
      c. Plant hardiness zones
      d. Altitude zones
    4. Air
      a. Pollution
      b. Soil aeration
      c. Water aeration
      d. Humidity
      e. Wind
    5. Soil
      a. Origins
      b. Texture
      c. Structure
      d. Soil water
      e. Soil minerals
      f. Organic matter
  F. Plant associations and successions
    1. Seaside
    2. Wet soil
  G. Applied ecology
    1. Forest ecology
    2. Landscape design
    3. Street tree planning

II. Shade Tree Ills
  A. Diagnosis and control measures
    1. Normality

        2. Health, a condition of well-being
        3. Symptoms of ill health
        4. Degrees of ill health
        5. Factors affecting plant growth
            a. Environmental
            b. Edaphic
            c. Biological
    B. Bark problems
        1. Mechanical injuries
        2. Environmental
        3. Diseases
        4. Insects
        5. Toxic substances
    C. Common diseases of common trees
        1. Leaf diseases
        2. Bark diseases
        3. Wood rots
        4. Wilt organisms
        5. Root diseases
    D. Common shade-tree insect pests
        1. Leaf insects
            a. Leaf eaters
            b. Sap suckers
            c. Burrowers
        2. Bark borers
        3. Wood borers
    E. Environmental troubles
        1. Drought or dryness
        2. Extreme heat or cold
        3. Salt spray
        4. Wind
            a. Desiccation
            b. Growth effects
            c. Damage
    F. Soil
        1. Composition
            a. Texture
            b. Structure
            c. Organic content
            d. Origins
        2. Problems
            a. Aeration
            b. Drainage
            c. *p*H
            d. Fertility
    G. Animals causing illness
        1. Rodents
        2. Birds
        3. Dogs

III. Pesticide Application
    A. Equipment
        1. Hydraulic sprayers
        2. Forced air blowers
        3. Fogging machines
        4. Airplanes and helicopters
    B. Application
        1. Proper materials and accurate formulation
        2. Thoroughness and timeliness
        3. Fruit tree seasonal schedules
        4. Shade trees
            a. Dormant and delayed dormant
            b. Canker worm spray
            c. Summer sprays
    C. Precautions
        1. Injury to trees
            a. Blast effect
            b. Overconcentration
            c. High temperatures
            d. Incompatible mixtures
            e. Herbicide residues
        2. Plant susceptibility
            a. Sugar maple, beech, and magnolia
            b. Stone fruits
            c. Evergreens
        3. Health and safety always
            a. Observe safety regulations
            b. Know relative toxicities
            c. Know emergency first aid
            d. Know nearest poison control center

Recommended Laboratory Projects—48 hours

I. Do field studies of plant succession (9 hours). Examples:
    A. Hydrosere—pond to swamp forest
    B. Mesosere—bare ground to forest
    C. Xerosere—seaside and desert
II. Make diagnostic studies of ailing established trees and report as directed (12 hours).
III. Go on a field trip and visit a field station or laboratory to study tree diseases (3 hours).
IV. Study the design and operation of several pieces of spray equipment and prepare reports (6 hours).
V. Use the operator's manual and service several pieces of spray equipment (3 hours).
VI. Prepare spray and dust equipment for storage (3 hours).
VII. Execute one or more spray schedules using various equipment (12 hours).

Texts and References

FENSKA. *Tree Experts Manual.*

PIRONE, DODGE *and* RICKETT. *Diseases and Pests of Ornamental Plants.*

PIRONE. *Tree Maintenance.*

POTTS. *Concentrated Spray Equipment.*

Proceedings of International Shade Tree Conference.

Instructional Aids

Pictures and colored slides
Pest control equipment
Abundance of established trees
Accumulated specimens of tree ills

TRAINING ORNAMENTAL AND FRUIT PLANTS

Hours Required

Class, 2; Laboratory, 3

Course Description

This course provides a knowledge of principles and develops some skills in the control of plant growth and form. Ornamental plants are fitted for their intended uses largely through pruning techniques. Pruning is taught as the systematic removal of plant parts for particular purposes. An understanding of how and why plants grow in certain ways is needed for a full grasp of this subject. The aesthetic qualities of training ornamental plants are major considerations. Practical reasons for pruning fruit producing plants are studied. Skills are practiced and developed in the laboratory.

Major Divisions

	Class Hours
I. Plant Growth Controls	4
II. Pruning	2
III. Care of Fruit Plants	8
IV. Espaliers	2
V. Rose Pruning	2
VI. Evergreens	4
VII. Deciduous Shrubs	2
VIII. Small Trees	2
IX. Hedges	4
X. Woody Vines	2
Total	32

Units of Instruction

- I. Plant Growth Controls
  - A. Nature of plant growth
    - 1. Genetic difference and growth habits
      - a. Vines
      - b. Shrubs
      - c. Trees
    - 2. Determinate and indeterminate growth
    - 3. Types of meristems
    - 4. Bud characteristics
    - 5. Polarity in plants
    - 6. Hormones and growth
    - 7. Nutritional balance
    - 8. Effects of pruning on growth of wood plants
      - a. Flower and fruit
      - b. Vigor (juvenility)
      - c. Dwarfing
      - d. Sprouting
  - B. Environmental factors
    - 1. Edaphic
    - 2. Temperature and water
    - 3. Light
  - C. Chemical control
- II. Pruning
  - A. Reasons for pruning
    - 1. Production
    - 2. Safety
    - 3. Health
    - 4. Appearance and visability
    - 5. Rejuvenation
    - 6. Dwarfing
  - B. Types of pruning
    - 1. Fruit and shade trees
    - 2. Topiary
    - 3. Timber
    - 4. Landscape
  - C. Pruning tools
  - D. Timing and frequency
- III. Care of Fruit Plants
  - A. Landscape values of fruit plants
  - B. Reasons for unfruitfulness
  - C. Training of fruit plants
  - D. Propagation
  - E. Techniques of fruit pruning
    - 1. Pome fruits
    - 2. Drupe fruits
    - 3. Grape and blueberry
    - 4. Brambles
  - F. Common problems of fruit plants
    - 1. Insects, diseases, and rodents
    - 2. Protection
  - G. Dwarf trees
- IV. Espaliers
  - A. Forms
  - B. Techniques
- V. Rose Pruning
  - A. Everblooming garden forms
    - 1. Hybrid tea rose
    - 2. Floribunda—bush roses
    - 3. Grandiflora—bush roses, crosses of floribunda, and hybrid tea roses
  - B. Shrub roses
  - C. Climbing or trailing roses
    - 1. Rambler type
    - 2. Large-flowered climbers
- VI. Evergreens
  - A. Conifers

    1. "Spurt" growers such as pine, spruce, and fir
    2. "Repeat" growers such as taxus, hemlock, juniper, and arborvitae
  B. Broad-leaved evergreens such as holly, boxwood, barberry, and rhododendron

VII. Deciduous Shrubs
  A. Basal growers
  B. Intermediate growers
  C. Terminal growers

VIII. Small Trees
  A. Containment by pruning
  B. Selections of small trees

IX. Hedges
  A. Purpose
  B. Types of plants
  C. Forms as good and bad
  D. Maintainance
    1. Hand and power tools
    2. Techniques

X. Woody Vines
  A. Wisteria
  B. Honeysuckle

Recommended Laboratory Projects—48 hours

I. Prune apples (3 hours).
II. Prune pears (3 hours).
III. Prune dwarf fruit trees (3 hours).
IV. Prune peaches, plums, and cherries (3 hours).
V. Prune brambles, blueberries, and grapes (3 hours).
VI. Graft or bud fruit plants in the nursery (3 hours).
VII. Prune and train espaliers (3 hours).
VIII. Prune and train roses (6 hours).
IX. Prune and train hedges (6 hours).
X. Prune evergreens (9 hours).
XI. Prune shrubs, small trees, and vines (6 hours).

Texts and References

CHRISTOPHER. *The Pruning Manual.*
State and Federal bulletins.

Instructional Aids

An operating orchard
An operating nursery
Landscaped campus and gardens
Color slides of special topics
Diagrams and charts of pruning practices

TREE PRUNING AND REPAIR

Hours Required

Class, 1; Laboratory, 3

Course Description

A course designed for students of ornamental horticulture who need to know how to plant, train, prune, protect, and repair trees. Tree maintainance is practiced on municipal, residential, and industrial properties and in parks, golf courses, and cemeteries. The course is strongly oriented to practical exercises and candidates must be physically fit, agile, and able to climb and work in trees. Natural hazards of field experience preclude persons who are not able to perform work effectively because field experience is essential if skills are to be developed. The laboratory experience is gained by working on trees of wide variety—the work being done in moderate weather.

Major Divisions

	Class Hours
I. Overview of the Arborist Industry	2
II. Safety for Tree Workers	1
III. Tree Anatomy	2
IV. Tree Physiology	1
V. Photosynthesis, Nutrition and Growth	1
VI. Objectives of Pruning	1
VII. Treatment of Tree Wounds and Defects	1
VIII. Techniques of Pruning Trees	2
IX. Pruning Standards	1
X. Lightning Protection for Trees	1
XI. Cabling and Bracing	1
XII. Tree Feeding	2
Total	16

Units of Instruction

I. Overview of the Arborist Industry
  A. Titles
    1. Topiarist
    2. Tree warden
    3. Arborist
    4. Arboriculturist
    5. Dendrician
    6. Dendrologist
    7. Tree surgeon, and others
  B. Scope of arborist activities
    1. Municipal and contract work
      a. Parks and parkways
      b. Street and housing projects
      c. Civic centers
      d. Civic institutional grounds
    2. Utility and contract work
      a. Right of way maintainance
      b. Line clearance
      c. Brush control
    3. Private and general care of trees on home properties and estates
    4. Commercial and contract spraying and pruning of trees
      a. Industrial landscaping
      b. Nurseries
      c. Cemeteries
      d. Real estate developments
  C. Opportunities for trained arborist personnel
    1. Dendrician
    2. Foreman
    3. Field representative
    4. Superintendent of grounds
      a. Schools, industrial sites, arboretums, estates, and institutions
      b. Golf courses and cemeteries
    5. Park service work as municipal, county, State, and national
    6. Owner and operator of a tree business
      a. Pruning, removals, spraying, fertilizing, and tree surgery
      b. Transplanting
  D. Skills of a successful arborist
    1. Horticultural
      a. Basic horticulture
      b. Plant identification
      c. Entomology
      d. Plant pathology
      e. Landscape appreciation
      f. Plant propagation
      g. Plant nutrition
      h. Soils and drainage
    2. Power equipment
    3. Speech and writing
    4. Human relations
    5. Salesmanship image
    6. Business ability
      a. Financing, accounting, record keeping, business, and shade tree law

- b. Estimating, pricing, insurance, labor laws, billing for service, planning ahead, and making a profit
- c. Government regulations

- II. Safety for Tree Workers
  - A. Accidents and unanticipated interruptions in the day's work
  - B. Effects of accidents on efficiency, production, and profits
  - C. Basic causes of accidents
    - 1. Worker's ignorance
    - 2. Poor training and inexperience
  - D. Personality factors
    - 1. Attitude
    - 2. Carelessness
    - 3. Indifference
    - 4. Laziness
    - 5. Ineptitude
    - 6. Inattention
  - E. Faulty equipment
  - F. Failure to observe safety rules

- III. Tree Anatomy
  - A. Twigs and external features
    - 1. Buds and leaves
    - 2. Nodes and internodes
    - 3. Bud scares
    - 4. Lenticels
    - 5. Epidermis and bark
    - 6. Pigmentation
  - B. Internal structure
    - 1. Pith
    - 2. Xylem
    - 3. Phloem
    - 4. Cambium
    - 5. Cortex
    - 6. Bark fibers
    - 7. Epidermis
    - 8. Abscission layers
  - C. Mature stems
    - 1. Sectional veins
      - a. X-section
      - b. Longitudinal
      - c. Tangential
    - 2. Heartwood
    - 3. Sapwood
    - 4. Wood rays, growth rings and branch traces
    - 5. Cambium, phloem, bark, and cork cambium
  - D. Roots
    - 1. Regions
      - a. Root tip and root cap
      - b. Elongation
      - c. Root hair zone
      - d. Maturation zone

- IV. Tree Physiology
  - A. Plant tissues
  - B. Vital plant processes
  - C. Absorption as osmosis
  - D. Conduction
  - E. Transpiration
  - F. Photosynthesis
  - G. Respiration
  - H. Growth (meristems)
  - I. Digestion
  - J. Translocation

- V. Photosynthesis, Nutrition and Growth
  - A. Anatomy of a leaf
    - 1. Petiole and blade
    - 2. Fibrovascular bundles
    - 3. Tissues
      - a. Epidermis
      - b. Chlorenchyma
    - 4. Mesophyll
      - a. Palisade parenchyma
      - b. Spongy parenchyma
      - c. Stomata
  - B. Food making, storage, and transportation
  - C. Food vs. nutrient
  - D. Plant nutrients
    - 1. Maemonia, Cu Mu Bo Zn C
    - 2. Hopkins Ca Fe Mg Mo Ba

- VI. Objectives of Pruning
  - A. Safety, public welfare, and liability
  - B. Health, disease eradication, and rejuvenation
  - C. Appearance and aesthetics
    - 1. Topiary pruning
    - 2. Vistas
    - 3. Espaliers
    - 4. Pollarding
    - 5. Dendroscope
    - 6. Tree forms
  - D. Production as fruit and timber
  - E. Line clearance
  - F. Controlling shade

- VII. Treatment of Tree Wounds and Defects
  - A. Bark injuries
    - 1. Skinned bark and bark tracing
    - 2. Sunscald and chemical injury
    - 3. Canker disease
    - 4. Borers and other insects
    - 5. Girdling

        6. Girdling roots
    B. Root injuries
        1. Suffocation
        2. Poor aeration
        3. Gas injury
        4. Fungus injuries
        5. Rodents
        6. Temperature
    C. Branch defects
        1. Wind and ice damage
        2. Rubbing branches
        3. Split and weak crotches
        4. Suppressed wood as drooping habit
        5. Duplication
        6. Witches' brooms

VIII. Techniques of Pruning Trees
    A. Pruning tools and pruning cuts
    B. Safe working practices

IX. Pruning Standards
    A. Fine, medium, safety prunings, and topping
    B. Creating aesthetic designs by pruning

X. Lightning Protection for Trees
    A. The nature of static electricity
    B. Lightning injury
        1. Exploded wood
        2. Bark stripping
        3. Root injury
    C. Lightning protection devices
        1. Types
        2. Installation practices
        3. Effectiveness

XI. Cabling and Bracing
    A. Materials
        1. Seven-strand cable
        2. Thimble
        3. Log hook, log bolts, and eye bolts (nuts and washers)
        4. Turnbuckles
        5. Log rods
    B. Tools
        1. Side-cut pliers
        2. Auger bits
        3. Sweep braces
        4. Power drill
        5. Windlasses, cable grips, and come-alongs
        6. Bolt cutters
    C. Cabling systems
        1. Direct, multiple direct
        2. Triangular
        3. Box
        4. Spoke and wheel
    D. Techniques of cabling and rodding

XII. Tree Feeding
    A. Foliar "feeding"
    B. Liquid "feeding" and ground injection
    C. Dry "feeding"
        1. Pneumatic
        2. Crowbar and ballpoint
        3. Earth auger
        4. Topdress
    D. Rates of application of dry feeding
        1. Arbitrary method—3–5 lbs. per diameter at breast height (DBH)
        2. Nitrogen measurement—1 lb. N per DBH
        3. Beilmann method
    E. Fertilizer materials
        1. Inorganic salts
        2. Organic fertilizer materials
        3. Synthetic organic
    F. Watering of trees
    G. Mulching of trees
    H. Mycorrhizae

Recommended Laboratory Projects—48 hours

I. Work with rope, knots and hitches (3 hours).
II. Practice climbing of mature trees (3 hours).
III. Climb trees and learn roping techniques (3 hours).
IV. Climb and prune trees with handsaw (6 hours).
V. Climb and prune with accessory tools (6 hours).
VI. Prune street trees (6 hours).
VII. Prune park and estate trees (6 hours).
VIII. Cable and brace trees (6 hours).
IX. Feed trees (3 hours).
X. Remove trees (3 hours).
XI. Axe trees (3 hours).

Texts and References

FENSKA. *Tree Experts Manual.*
PIRONE. *Tree Maintenance.*

Instructional Aids

Colored slides and pictures
Many trees of all kinds, ages, and condition
Hand and power tools and rope
Charts and diagrams of tree repairs

TURFGRASS CULTURE

Hours Required

Class, 2; Laboratory, 2

Course Description

An introductory course for students of Turf Management or Landscape Development. The art and science of turfgrass culture are introduced and developed through class and laboratory exercises.

Although a basic soils course is a prerequisite, additional emphasis is placed on soil as it relates to a successful turfgrass program. Much stress also is placed on fertilizer and water requirements for development of intensive turf areas, including golf courses, athletic areas, parks, industrial sites, and residential properties. Following the knowledge acquired of the soil, water, and fertilizer requirements, the students are introduced to the various turfgrasses and their uses. The identification of the seed and vegetative growth characteristics of various species and strains of specialized grasses are studied in detail.

The tolerance factors and growth limitations affecting grasses are studied with specific adaptations of each grass outlined. The susceptibility of certain grasses to disease infection is discussed. Weeds and insect pests are introduced in this course.

Major Divisions

	Class Hours
I. Introduction to Turfgrass Culture	1
II. Broad Factors Affecting Special-Purpose Turfgrass Production	2
III. Soil and Grass Relationships	4
IV. Drainage and Irrigation	4
V. Fertilizer and Lime Requirements	4
VI. Special-Purpose Grasses	4
VII. Turfgrass Propagation	4
VIII. Disease Identification and Control	3
IX. Weed Identification and Control	3
X. Insect and Other Pest Identification and Control	3
Total	32

Units of Instruction

- I. Introduction to Turfgrass Culture
  - A. Cultural aspects of turfgrasses
  - B. Statistics
    - 1. Economic
    - 2. Acreage
  - C. Areas of specialization
    - 1. Recreation and park areas
    - 2. Athletic field construction and maintenance
    - 3. Golf course design, construction, and management
    - 4. Industrial and municipal grounds management
    - 5. Turf maintenance and construction contracting
- II. Broad Factors Affecting Special-Purpose Turfgrass Production
  - A. Factors controlling production of turf
    - 1. Climate
      - a. Regions
      - b. Climatic factors
    - 2. Soil
      - a. Fertility
      - b. Aeration
      - c. *p*H
    - 3. Management
      - a. Establishment
      - b. Maintenance
      - c. Renovation
  - B. Basics of management program
  - C. Needs
    - 1. Research
    - 2. Manpower
- III. Soil and Grass Relationships
  - A. Basic soil requirements
    - 1. Suitable surface for seedbed
    - 2. Good physical properties
    - 3. Sufficient moisture holding capacity
    - 4. Adequate fertility to start and hold turf
    - 5. Conditions for desirable soil organisms
    - 6. Freedom from harmful chemical qualities
  - B. Physical properties
    - 1. Solid—approximately 50 percent
    - 2. Liquid—approximately 25 percent
    - 3. Gas—approximately 25 percent
  - C. Ideal proportions
    - 1. Gases (air)

      2. Water
         a. Zones
         b. Surface zone controls
         c. Intermediate root zone
         d. Subsoil zone
         e. Presence in soil
            (1) Gravitational
            (2) Capillary
            (3) Hygroscopic
      3. Solids
         a. Mineral (sizes)
         b. Groups (texture classes)
         c. Organic matter
            (1) Composition
            (2) Texture
         d. Organic materials
   D. Chemical properties of soils to turf management
      1. Essential elements
      2. Source of plant food
      3. Soil reaction
      4. Active and potential acidity
         a. Importance of water
         b. Role of fertilizers
      5. Effects on grasses
      6. Effects on availability of nutrients
      7. Effects on turf quality
      8. Effects on soil organisms
      9. Soil reaction tests
         a. For available nutrients
         b. Sampling
         c. Interpretation of results
         d. Tests for:
            (1) Nitrogen
            (2) Phosphorus and potassium
            (3) Magnesium and calcium
            (4) Other nutrients
      10. Plant tissue tests

IV. Drainage and Irrigation
   A. Drainage
      1. Effects of poor drainage
      2. Determining drainage requirements
      3. Surface drainage
      4. Tile systems
         a. Kinds
            (1) Regular
            (2) Intercepting
         b. Installation
      5. Other methods
      6. Air drainage
   B. Irrigation
      1. Functions
      2. Quantities necessary
      3. Soil conditions affecting availability and retention
      4. Determination of requirements
      5. Systems
         a. Sprinkler types
         b. Surface flooding
         c. Subsurface
      6. Water sources
      7. Pressure equipment
      8. Pipe lines
      9. Sprinkler heads
      10. Types and planning of systems
      11. Prevention of wilt and winter drying
      12. Time and frequency of watering
      13. Seasonal factors and adjustments
      14. Relationships between watering and fertilization

V. Fertilizer and Lime Requirements
   A. Commercial sources of fertilizers (sources of plant-food elements)
      1. Three most important elements
         a. Nitrogen
         b. Phosphorus
         c. Potassium
      2. Chemical fertilizers
         a. Natural sources
         b. Manufactured
         c. Combination of natural and manufactured
      3. Chemical compounds
         a. Organic
         b. Inorganic
      4. Classified—effects on soil reaction
         a. Increase acidity
         b. No effect
         c. Reduce acidity
   B. Nitrogenous materials
      1. Inorganics
      2. Organics
      3. Synthetic organics
   C. Phosphate materials
      1. Organic carriers (bone meal)
      2. Superphosphates (most important commercial source)
      3. Ammonium phosphates (quick-acting, caution)
   D. Potash materials
      1. Muriate of potash (outstanding source)
      2. Potassium sulfate (more expensive—less potash)
   E. Secondary and trace elements

- F. Mixtures of fertilizers
  - 1. Complete fertilizers
  - 2. Incomplete fertilizers
  - 3. Grade determination
  - 4. Definition of fertilizer formula
- G. Fertilizer formulations
  - 1. Classes of nutrient ratios
  - 2. Analysis determination
- H. Lime
  - 1. Function
    - a. Direct
    - b. Indirect
  - 2. Kinds and sources
    - a. Rock
    - b. Marl
    - c. Oyster shells
    - d. Slag
    - e. Commercial lime
      - (1) Calcium oxide (burned or quicklime)
      - (2) Calcium hydrate (hydrated or slaked lime)
  - 3. Rates, frequency, and time of application
  - 4. Other soil amendments
    - a. Gypsum
    - b. Sulphur

- VI. Special-Purpose Grasses
  - A. Effects of climate (regions)
  - B. Northern cool humid regions
    - 1. Permanent grasses
    - 2. Temporary grasses
    - 3. Miscellaneous grasses
  - C. Southern warm humid and southwest irrigated regions
    - 1. Permanent grasses
    - 2. Temporary grasses
    - 3. Miscellaneous grasses
      - a. Warm humid regions
      - b. Dry areas of southwest
  - D. Central regions of limited rainfall
    - 1. Permanent grasses
      - a. Where irrigated—all species of cool humid regions
      - b. Nonirrigated
    - 2. Temporary grasses
    - 3. Miscellaneous grasses
  - E. Grasses for greens
    - 1. Permanent
    - 2. Temporary (in South)
  - F. Grasses for tees
    - 1. Southern region
    - 2. Northern region
    - 3. West-central region
      - a. Irrigated—same as northern cool humid
      - b. Nonirrigated
  - G. Grasses for fairways (or general residential lawns)
    - 1. Southern region
    - 2. Northern region
      - a. Intensive management (close clipping)
      - b. Moderate watering and 1½" cutting height
    - 3. West-central region
      - a. Warmer sections (limited water)
      - b. Unwatered
      - c. Water available
  - H. Grasses for roughs and trap facings (minimum maintenance)
    - 1. Minimum penalties
      - a. Adjust mowing height and fertilization of fairway species
      - b. Control drainage
    - 2. Severe penalties
      - a. Northern region
      - b. Southern region
      - c. Southwest
      - d. West-central region
    - 3. Trap facings and bunkers
      - a. Dry and sandy slopes
      - b. Dunes, etc.
  - I. Characteristics of individual grass species
    - 1. Identification (vegetative)
    - 2. Requirements for growth
    - 3. Adaptability

- VII. Turfgrass Propagation
  - A. Seedbed preparation
    - 1. General considerations
      - a. Acceptable moisture level in soil
      - b. Initial grading
      - c. Loosening soil
      - d. Incorporation of soil conditioner, basic fertilizers, and lime as required by test
      - e. Sterilization for weeds and insects
      - f. Soil pulverizing and grading
      - g. Incorporation of starter fertilizer and final grading
      - h. Sowing of seed, spreading of stolons, or laying of sod
      - i. Watering and cutting
    - 2. Specific steps outlined

        - a. For large areas and use of power equipment
        - b. For small areas, primarily hand grading
- B. Seed quality and State regulations
    - 1. Germination percentage
    - 2. Purity percentage
    - 3. Date of test
    - 4. Names of seeds
    - 5. Weed seed content
    - 6. Inert matter
- C. Seeding
- D. Dormant seeding
- E. Mulching seedbeds
- F. Vegetative planting
- G. Sodding
    - 1. Spot sodding
    - 2. Sheet sodding
    - 3. Quality
    - 4. Procedures
- H. Greens construction
    - 1. Requirements
    - 2. Physical conditioning materials
        - a. Sand
        - b. Organic matter (preferably peats)
        - c. Other conditioning materials (cost major factor)
        - d. Soils
            - (1) Kinds directly affect additions of sand and peat
            - (2) Improvement of poor grades by composting
        - e. Ratios of soil, sand, and organic matter
    - 3. Procedures
        - a. Seedbed depth
        - b. Mixing operations
        - c. Fertilizer, lime and others
        - d. Rolling before seeding (not always necessary)
        - e. Grasses
        - f. Rate and time of seeding
        - g. Seeding methods
        - h. Rolling and mulching
        - i. Vegetative planting of greens
        - j. Watering
        - k. Clipping
- I. Winter greens
    - 1. Types of grasses
    - 2. Time of seeding
    - 3. Seeding rates
    - 4. Seeding method
    - 5. Fertilization
    - 6. Covering and watering
    - 7. First clipping
- J. Tees
    - 1. Grasses
    - 2. Planting procedures
- K. Fairways
    - 1. Seedbed preparation
        - a. Depth 6"–8"
            - (1) Plow
            - (2) Disc harrow
            - (3) Culti-packer or Meeker harrow (other trade-named pieces of equipment provide similar effects)
        - b. Lime, fertilizers and conditioners
            - (1) Rates
            - (2) Procedures of incorporation
    - 2. Planting
        - a. Grasses
        - b. Seed quality and mixtures (locality and exposure determining factors)
        - c. Methods of seeding
            - (1) Types of equipment
            - (2) Procedures
    - 3. Watering and cutting
- L. Roughs and nonused areas
- M. Turf nurseries

VIII. Disease Identification and Control

- A. Nature of diseases
- B. Conditions favorable for diseases
    - 1. Moisture (soil and air)
    - 2. Temperature (each fungus has own optimum)
    - 3. Soil acidity (high favors fungus growth)
    - 4. Soil fertility (low favors fungus growth)
    - 5. Matted turf (including thatch)
- C. Disease prevention
    - 1. Cultural practices
    - 2. Resistant grasses
    - 3. Fungicides
- D. Disease detection and treatment
- E. Injuries resembling diseases
    - 1. Winter injuries
    - 2. Summer injuries
    - 3. Chemical injuries
    - 4. Mechanical injuries
    - 5. Insect injuries
    - 6. Poor cultural practices

IX. Weed Identification and Control

- A. Methods of control

   1. Prevention
   2. Eradication

B. Identification

C. Cultural control practices
   1. Prior to seeding
   2. Mowing
   3. Fertilizing
   4. Watering
   5. Aeration
   6. Use of adapted grasses

D. Chemical control
   1. Preseeding treatments
      a. Soil sterilants
      b. Soil conditioners
   2. Chemical weed killers
      a. Two general classes
      b. Post-emergence herbicides effective on weeds in turfgrass
      c. Pre-emergence herbicides

E. Weed control on greens
   1. Eradication in top dressing material
   2. Protection against invasion from other sources
   3. Hand weeding
   4. Control by spotting
   5. Control by broadcasting chemicals

F. Weed control on tees (generally as control procedures on greens)

G. Weed control on fairways (essential phases of control on fairways)
   1. Insuring good turfgrass cover
      a. Determination and correction of invasion conditions
      b. Use of cultural practices and chemical controls
      c. Use of adapted grasses and maintenance practices
   2. Drainage
   3. Soil compaction and poor structure
   4. Lime and fertilizer
   5. Adjustment of clipping height and watering
   6. Reseeding with adapted grasses
   7. Chemical weed control
   8. Prevention of reinfestations

H. Weed control in roughs and nonuse areas

X. Insect and Other Pest Identification and Control

A. Types of damage
   1. Foliar and root
   2. Soil pests (nonplant feeders)

B. Insect groups
   1. Root attackers
   2. Foliar feeders
   3. Sucking insects

C. Insecticides and their uses
   1. Liquid vs. dry applications
   2. Wash into soil vs. leave on surface
   3. Frequency of application
   4. Kinds of insecticides

D. Control methods for insects and other pests
   1. Know life cycle
   2. Insects
   3. Animal pests
   4. Safety precautions in use of pesticides

Recommended Laboratory Projects—32 hours

I. Visit a comprehensive park area (2 hours).

II. Acquire and analyze soil samples for turf areas (4 hours).

III. Prepare fertilizer formulations (4 hours).

IV. Identify vegetative grass plant characteristics (4 hours).

V. Identify grass seeds (2 hours).

VI. Prepare seed mixture formulations (4 hours).

VII. Identify grass diseases (4 hours).

VIII. Identify weeds (4 hours).

IX. Identify insects and miscellaneous turf pests (4 hours).

Texts and References

BROOKLYN BOTANICAL GARDENS. *Handbook on Lawns.*
COUCH. *Diseases of Turfgrasses.*
FOGG. *Weeds of Lawn and Garden.*
HITCHCOCK. *Manual of the Grasses of the United States.*
JAQUES. *How To Know the Insects.*
———. *How To Know the Weeds.*
MUENSCHER. *Weeds.*
MUSSER. *Turf Management.*
SCHERY. *The Lawn Book.*
SUNSET. *Lawn and Ground Cover Book.*
U.S. DEPARTMENT OF AGRICULTURE YEARBOOK (1948). *Grass.*
———. (1956). *Insects.*
———. (1953). *Plant Diseases.*
———. (1955). *Water.*
———. (1957). *Soil.*
———. (1958). *Land.*
———. (1961). *Seeds.*

Periodicals:
The Golf Course Reporter
Golfdom

California Turfgrass Culture
Park Maintenance
U.S.G.A. Journal and Turf Management
Park and Recreation
Seedsmen's Digest

Instructional Aids

Charts, diagrams, and drawings
Private collection of 35mm. slides

TURFGRASS FOR GOLF COURSES

Hours Required

Class, 2; Laboratory, 3

Course Description

This course is a study of the problems, principles, and practices involved in the design of turf areas for golf courses. Turf areas are of prime importance for the success of golf courses. A sound knowledge of golf from the standpoint of a golfer is essential to good design. The excellence of turf quality is not appreciated fully if the course design is uninteresting or the locations of hazards penalize the average golfer unfairly.

Information learned in Landscape Design, Surveying, Plant Identification, Turf Management and all related technical courses are utilized in this course. Students are required to present their recommendations toward solving a golf course design problem.

Additional design problems are presented that require research and effort. These practical problems help students to summarize information acquired in preceding courses and also test their ability to comprehend and utilize information taught throughout this program. Each problem is worked on by teams of students which enables them to base final decisions on group ideas and discussions.

Major Divisions

	Class Hours
I. Review of Design Principles and Drafting Techniques (based on Landscape Plans I)	4
II. Golf Course Site Selection	5
III. Topographical Survey and Mapping	6
IV. General Plans	5
V. Detail Plans, Soil Testing, and Planting Plans	6
VI. Turfgrass Problem Analysis, Solving and Reporting	6
Total	32

Units of Instruction

I. Review of Design Principles and Drafting Techniques (based on Landscape Plans I)
  A. Principles of design
    1. Simplicity
    2. Opposition
    3. Transition
    4. Repetition
    5. Balance
    6. Scale
  B. Types of plans
  C. Space usage
  D. Traffic circulation
  E. Plant materials
  F. Construction details
  G. Drawing and drafting techniques

II. Golf Course Site Selection
  A. Property size
    1. Dependent on type of course
      a. Regulation 18-hole
      b. 9-hole
      c. Par 3
    2. Provide adequate size
      a. Safety
      b. Interest
      c. Ease of design
      d. Future expansion
  B. Selection considerations
    1. Accessibility
    2. Adequate size
    3. Topography
    4. Adequate water
    5. Cost of land
    6. Fertile soils
    7. Population projections
    8. Prevailing winds in relation to property shape
    9. Native trees and shrubs
  C. Topography
    1. Gently rolling
    2. Abrupt grade changes
  D. Shape, dimensions and orientation
    1. Major dimension
    2. Avoid long narrow properties
    3. Golden mean (ideal proportions)
    4. Avoid parallel holes
  E. Parties involved
    1. Future superintendent
    2. Club professional
    3. Club officials
    4. Designer or architect

III. Topographical Survey and Mapping
  A. Land survey
    1. By qualified engineer or land surveyor

3

and agronomist
  2. Accurate to 1-ft. elevation difference
B. Mapping
  1. All construction and design based on this survey
  2. Drawn in large scale 50-60 ft. to the inch, and specific areas in 10-20 ft. to the inch
  3. Include
    a. Wooded areas
    b. Small plant groupings and individual large trees
    c. Streams, ponds, and other features
    d. Buildings, utilities, and sanitary lines
  4. Soils map
  5. Profiles and cross sections
  6. Aerial surveys

IV. General Plans
  A. Preliminary plans
    1. Group ideas
    2. Parties reviewing plans (same as Unit II, section E)
    3. Several plans should be presented
    4. Plans should include all areas
  B. Accepted general plan
    1. Often a composite of several preliminary plans
    2. Planned so costs can be spread out
    3. Planned to expedite orderly construction
    4. Planned to expedite early and orderly play
    5. Necessities of prime importance
    6. Club cart considerations
    7. Frills kept to minimum
    8. Minimum grade changes
  C. Type of player and course
    1. Quality of golfer
    2. Public course
    3. Private course
    4. Expected golf traffic
    5. Plan for various degrees of proficiency
  D. Length of course
    1. Short
    2. Average
    3. Long
  E. Rotation of hole length
    1. Mix length (par)
    2. Prevent lining equal par holes consecutively
    3. Accepted standard
      a. 4 par 5, 10 par 4, and 4 par 3
      b. Divide evenly within front and back 9 hole portions

V. Detail Plans, Soil Testing and Planting Plans
  A. Tee design
    1. Utmost importance
    2. Blend into natural grade
    3. Blend into surrounding plantings
    4. Location (smooth traffic flow)
    5. Size and shape
    6. Detail plan and cross sections
    7. Alternate units
    8. Plant materials
    9. Irrigation and drainage
    10. Allowance for player backup, rest, ball wash, and water fountain
    11. Safety
  B. Fairway design
    1. Variation individual design
    2. Conform to natural terrain
    3. Ease of maintenance
    4. Number and location of traps
    5. Tree and shrub location and removal
    6. Delineate limitations
    7. Width considerations
    8. Use of dog legs
    9. Detail drawings (plan, profile, and cross section)
    10. Allowances for cart traffic
    11. Irrigation and drainage
    12. Safety
  C. Greens design
    1. Size (putting surface related to entire area)
      a. Small
      b. Medium
      c. Large
      d. Relate size to hole length and approach
    2. Detail plan and cross section drawings
      a. Entire greens area, including:
        (1) Traps
        (2) Immediate approach
        (3) Plantings
      b. Cross sections and profiles in exaggerated scale
    3. Avoid abrupt changes
    4. Drainage and irrigation systems
    5. Shape
    6. Trap location
    7. Shoulder or collar areas

8. Avoid narrow peninsulas or islands
9. Consider cart traffic
10. Direction to next tee
11. Trees and shrubs
12. Safety
13. Maintenance reduction

D. Traps
  1. Drainage
  2. Ease of maintenance
  3. Fairways
    a. Gentle slopes
    b. Blend into fairway
    c. Minimum bunker slope
    d. Easily seen
    e. Direction not penalized
  4. Plant material choice and location
  5. Greens
    a. Location (nearness to green)
    b. Size
    c. Shape
    d. Quantity

E. Building and shelter design

F. Practice areas
  1. Putting green
  2. Chipping and pitching area
  3. Driving and long iron area

G. General areas
  1. Parking and roads
  2. Tennis court and swimming pool
  3. Clubhouse and pro shop
  4. Ornamental plantings

VI. Turfgrass Problem Analysis, Solving and Reporting
  A. Determine problem
  B. Analyze
  C. Solve
    1. Past knowledge
    2. Research
      a. Literature
      b. Laboratory
    3. Inquiry
    4. Keep records
    5. Specialist's aid
  D. Reporting
    1. Materials and equipment required
    2. Procedures
    3. Form
      a. Concise
      b. Accurate
      c. Orderly
      d. Grammatically correct

Recommended Laboratory Projects—48 hours

I. Review technique exercise with drafting instruments (3 hours).
II. Prepare preliminary general plans for a golf course (9 hours).
III. Prepare topographic maps from surveyor's grades (9 hours).
IV. General plan (9 hours).
V. Detail plans and drawings (9 hours).
VI. Prepare a cultural type of problem that requires research, testing, and a written technical report (9 hours).

Texts and References

Notes, texts, references, and literature from previous courses.

Instructional Aids

35 mm slides
Field trips to golf courses
Plans of golf courses

TURFGRASS MANAGEMENT I

Hours Required

Class, 1; Laboratory, 6

Course Description

This course is designed to provide students of Turf Management with a firsthand opportunity to adapt, as well as see the application of, theories and principles taught in Turfgrass Culture.

The course is laboratory-oriented and includes many field trips to golf courses, sod farms, and other intensively maintained turf areas so that students can observe the practices of various types of turf specialists. In this way, students gain insight into the tasks performed by turf specialists and learn several methods of coping with problems related to turfgrass culture and management.

As part of the laboratory exercises, students have responsibility for managing the fine turf areas within the school's ornamental horticulture gardens. This includes fertilizing, clipping, and watering turf areas, and controlling weeds, insects, and diseases. Renovation and construction of turf areas by sodding, seeding, aeration, and thatch removal are integral parts of the laboratory exercises.

Students construct and maintain turf plots of various grass species and strains. These plots require simple cutting and students develop fertilizer, soil, exposure, and water requirement tests. The plots and school gardens are open for public observation throughout the year.

Major Divisions

	Class Hours
I. Introduction and Scope of Work	1
II. Test Plot Observation and Management	4
III. Turfgrass Propagation	5
IV. Turfgrass Maintenance	6
Total	16

Units of Instruction

I. Introduction and Scope of Work
  A. Knowledge and understanding of essentials
    1. Proper use of area
    2. Financial requirements
    3. Degree of maintenance required
    4. Equipment required
    5. Water and drainage requirements
  B. Projects covered in course
    1. Irrigation system installation
    2. Drainage system installation
    3. Propagation
      a. Seed
      b. Vegetative
      c. Sod
    4. Test-plot maintenance
      a. Green and tee grass species and strains
      b. Fairway and residential lawn species and strains
      c. Rough and minimum maintenance area turf
    5. Ornamental garden turf areas
  C. Field trips
    1. Golf courses
    2. Parks
    3. Industrial sites
    4. Commercial sod growers
    5. Commercial seed and supply house

II. Test Plot Observation and Management

This observation program is intended to acquaint the student with firsthand knowledge of information already known, and is not expected to be an investigation of the unknown such as performed at experiment stations throughout the Nation. From this course the students will gain an insight into the tasks confronting scientists in the turf field.

  A. Use of prominent locations grass species and selections
    1. No tests for diseases (program not experimental)
    2. Simple, practical, and proved methods of management
    3. Comparisons among proved selections within climatic area
    4. Attempt to observe under playing conditions similar to method used by USGA Greens Section
    5. Use of following:
      a. Various cutting heights
      b. Various watering rates
      c. Various fertilizer applications
  B. Comparison of many species and selec-

tions of general use grasses for fairways, residential and industrial turf areas

1. Sow all seed with available manpowered commercial spreaders
2. Attempt to have each seed selection in full sun through partial shade to full shade, and observe which grasses do best in various conditions and in competition with shrubs and trees
3. Thickness of topsoil and subsoil composition will vary very much as it does on most golf courses and other turf areas. Observe variations in vigor of each selection
4. Apply commercially available fertilizers, herbicides, fungicides, insecticides, and conditioners at right angles over each selection with commercially available spreaders
    a. Observe results of various fertilizer application rates
    b. Observe effects of various materials on each selection
5. Mow across each band of grass with several types of mowers set at various heights.
    a. Observe type of cut with each mower
    b. Observe effects of various cutting heights on each selection
6. Water is applied at various rates to show the response of all selections to their own optimums.
    a. Too much and too little water
    b. Recognition of the variation of soils

III. Turfgrass Propagation

A. Supplement lecture material of Turfgrass Culture

B. General seeding procedures (new turf construction)

1. Adequate moisture
2. Apply (based upon soil analysis)
    a. Lime
    b. Phosphorus
    c. Potash
    d. Soil conditioner
3. Incorporate into top 5″–6″
4. Grade to within 2″–3″ final grade, and remove stones over 2″ size from top 2″–4″
5. Roll if soil is not firm after grading the regrade
6. Apply starter fertilizer (complete), 50% organic, at rate of 2 lbs. of nitrogen per 1,000 sq. ft.
7. Incorporate into top 2 inches. This operation also produces the final grade
8. Light rolling may be necessary. If so the surface should then be scarified lightly to enable it to receive the seed properly
9. Sow seed at rate of 5 million viable seed per 1,000 sq. ft. or apply stolons or sprigs (bentgrass stolons at rate of 8-10 bushels per 1,000 sq. ft.). Roll vegetative material lightly into soil
10. Cover seed approximately ¼″ by light raking or grading, or by applying ½-⅔ cu. yd. of a top dressing soil mixture per 1,000 sq. ft. If vegetative material is used cover area with approximately ½ cu. yd. of top dressing soil mixture per 1,000 sq. ft.
11. Roll area, whether it is seeded or vegetatively planted, with a light roller to firm seed or stolons into contact with soil
12. Mulch at this point if desirable
13. Water area with a light spray and keep damp until seed germinates or vegetative material develops strong roots and new top growth
    a. Care should be taken not to saturate, wash soil away, or allow soil to dry out
    b. After germination, water sparingly, and lengthen time between waterings to prevent disease and shallow roots
14. Begin clipping at the desirable height once the grass exceeds the planned maintenance height of ½″-1″.
    a. Bent grasses and Bermuda grasses on greens are clipped first at ½″ plus or minus and reduced gradually over a 3 to 4 week period after sod has developed at the initial cutting height
    b. Other grasses are maintained at the desirable height from the first clipping
15. Nitrogen should be applied in a complete fertilizer 6-8 weeks after seeding. This fertilizer application can be in the same form as that used in the prep-

aration of the seedbed and at double the rate (4 lbs. of nitrogen) if it is at least 50% organic

16. Follow prescribed management practices from this point

    Note: Soil sterilants may be used in seedbed preparation at various points, depending upon the sterilant

C. Sod lifting and laying
  1. Procedures for lifting
    a. Mechanical compared to manual methods
    b. Thickness
    c. Desirable condition (vigor, age and uniform thickness)
    d. Size of strips
    e. Stacking
    f. Rolled compared to square or strips
  2. Laying procedures
    a. Bed preparation (same as for seeding)
    b. Handling
    c. Placing
    d. Matching thickness and edges
    e. Toeing exposed edges
    f. Firming
    g. Watering
    h. Clipping
    i. Pegging or holding in place
    j. Use of area
  3. Advantages and disadvantages of using sod
    a. Season of year
    b. Contour or grade of area
    c. Cost
    d. Time
    e. Availability

D. Dormant seeding
  1. Advantages and disadvantages
  2. Precautions
  3. Time
  4. Mulching

E. Renovation (surface cultivation)
  1. Aerating
    a. Signs of need
    b. Time
    c. Methods and equipment
    d. Frequency
  2. Thatch removal
    a. Signs of need
    b. Time
    c. Methods and equipment
    d. Frequency
  3. Combination of aerating and thatch removal
    a. Same as E-1 and E-2
    b. Application of fertilizer, lime, etc.
    c. Methods of sowing of seed
    d. Part of overall management program

IV. Turfgrass Maintenance

A. Turf quality requirements
  1. Greens
  2. Tees
  3. Fairways (general residential, park and commercial areas)
  4. General minimum use areas

B. Maintenance of greens
  1. Polling
    a. Breaks up dew drops and permits a more even finished surface after clipping
    b. Spreads worm casts
  2. Brushing
    a. Relieves matting
    b. Relieves excessive stem conditions
    c. Provides for more uniform cut
  3. Vertical mowing
    a. Breaks up excessive stoloniferous growth
    b. Loosens and removes accumulated organic material buildup from plants
    c. Encourages air circulation
    d. Helps prevent disease (development)
    e. Permits water and nutrients to enter soil easier
  4. Clipping
    a. Heights vary
    b. Change clipping heights gradually
    c. Periods between clippings vary
    d. Removal of clippings
  5. Fertilizer and lime
    a. Ratios
    b. Rates of availability
    c. Frequency
    d. Equipment
    e. Rates of application
    f. Should use dolomitic limestone
  6. Top dressing
    a. Improve surface
    b. Modify soil conditions
    c. Apply lightly
    d. Not a routine procedure

    - e. Not a permanent improvement
    - f. No standard procedure
    - g. Use a mixture of soil, sand, and organic matter
    - h. Should sterilize
    - i. Expensive

C. Renovation of greens (specialized maintenance procedure)

- 1. Ideal time varies with climatic region
- 2. Correct drainage
- 3. Correct compaction
- 4. Remove thatch
- 5. Remove weeds and other undesirable vegetation
- 6. Reseeding and vegetating
- 7. Replace unadapted grasses
- 8. Removal of soil and sand layers
- 9. Correction of tree and shrub competition

D. Apron maintenance

- 1. Clipping
- 2. Watering
- 3. Pest control
- 4. Relocation of traps
- 5. Maintain easy grade
- 6. Aeration, thatch removal and top dressing

E. Maintenance—fairways and other large turf areas

- 1. Mowing
    - a. Height
    - b. Frequency—¼" - ½" of blade removal each cutting
    - c. Equipment
- 2. Fertilization
    - a. Same principles as applied to greens
    - b. Rate of application based upon:
        - (1) Grass used
        - (2) Soil
        - (3) Water application
        - (4) Traffic
    - c. Lower quantities usually needed than on greens
        - (1) Bluegrass, fescue mixture, 4-5 lb. per 1,000 sq. ft., or 150-200 lb. per acre of a complete fertilizer if unwatered
        - (2) If watered, increase application by approximately 50%
    - d. Equipment
- 3. Lime applications
    - a. Based upon *p*H tests
    - b. Based upon grasses
    - c. Equipment
    - d. Time of application
- 4. Watering and pest control discussed thoroughly in earlier portion of this course and in Turfgrass Culture course

F. Fairway and large turf area renovation

- 1. Reasons for poor turf in these areas
    - a. Unadaptable grasses
    - b. Poor physical properties of the soil
    - c. Poor drainage
    - d. Low fertility
    - e. Poor maintenance practices
        - (1) Improper watering (too little or too much)
        - (2) Improper clipping procedure
    - f. Insect and disease injury
    - g. Miscellaneous pest injury, accidents, and vandalism
- 2. Materials for correction
- 3. Equipment necessary
- 4. Procedures for correcting areas heavily infested with annual bluegrass
    - a. Correct drainage
    - b. Destroy weeds and undesirable vegetation (late August) with sodium arsenite—40 lb./100 gal. water/acre
    - c. Aerate (aid drainage and correct compaction)
    - d. Apply fertilizer and lime per soil analysis
    - e. Use thatching unit to remove excess vegetative residues and disperse fertilizer and lime into aerator holes
    - f. Allow to lie until fall crop of annual bluegrass germinates
    - g. Spray new annual bluegrass with 25 lbs. sodium arsenite per acre
    - h. Loosen surface to remove trash accumulations
    - i. Seed
    - j. Drag with chain link fence or similar tool
    - k. Roll lightly

G. Maintenance of tees

- 1. If tees are large, follow general procedures for greens
- 2. Maintain grass height above that of greens
- 3. Move markers frequently
- 4. Keep turf in vigorous condition
- 5. Renovation usually means reconstruction
- 6. Sod not a good solution to bare spots

   7. Equipment
- H. Maintenance of rough and minimum maintenance areas
  1. Height of cut
  2. Frequency of cut
  3. Equipment
  4. Fertilizer and lime
  5. Water
- I. Maintenance of traps and bunkers
  1. Sand texture
  2. Raked regularly
     a. Methods and frequency
     b. Effect of weather
  3. Weed control
  4. Mowing height of fringe grass and bunkers
  5. Fertilizers
  6. Equipment

Recommended Laboratory Projects—96 hours

- I. Construct or reconstruct and maintain test plots (36 hours).
- II. Construct, or renovate, and maintain turf areas within ornamental garden area using seed and sod (36 hours).
- III. Visit golf courses (12 hours).
- IV. Visit sod farms (6 hours).
- V. Visit commercial seedsman warehouse (6 hours).

Texts and References

Same used for the Turfgrass Culture course.
Lecture notes from the Turfgrass Culture course.

Instructional Aids

Same used for the Turfgrass Culture course

TURFGRASS MANAGEMENT II

Hours Required

Class, 2; Laboratory, 3

Course Description

This course is a continuation of Turfgrass Management I with emphasis on the business procedures of turf management. Since many students eventually will have maintenance and managerial responsibility for the turfgrass culture of golf courses, parks, school grounds, government properties, industrial grounds, estates, cemeteries, and private grounds, they will need an understanding of sound business procedures. All forms of recordkeeping required for the turf industry cannot be taught, but the course provides knowledge of basic procedures which can be adapted to any situation.

Analysis and use of work-time studies, material and equipment costs, depreciation costs, overhead costs, direct and indirect costs, and labor force requirements are studied. Procedures followed in the preparation of cost estimates consider the relationship of each operation and decision to management costs in the turfgrass business. Efficient operation as well as economy is stressed.

Specialists in the turf field are invited to lecture on proved techniques and procedures. Field trips, to observe and analyze methods, business procedures, and cost analysis methods, are a part of the laboratory exercises. Other laboratory periods focus on analyzing and solving various technical and financial problems related to turfgrass culture and operations.

Major Divisions

	Class Hours
I. Scope of Course	1
II. Organization Problems	4
III. Computations of Areas and Quantities	5
IV. Material and Equipment Costs (Original and Replacement)	5
V. Labor Costs	4
VI. Overhead Costs	4
VII. Recordkeeping, Estimating, and Inventories	6
VIII. Costs, Markup, and Profit	3
Total	32

Units of Instruction

I. Scope of Course
  A. Importance of recordkeeping
    1. Efficiency of operation
    2. Importance of cost analysis
  B. Budgetary factors
    1. Time
      a. Men
      b. Equipment
    2. Available funds
    3. Professional services
      a. Legal
      b. Accountant
      c. Technical specialists
  C. Efficient overall management
    1. Labor
    2. Equipment
    3. Construction and renovation projects

II. Organization Problems
  A. Golf courses (superintendent's responsibility to different superiors)
    1. Private
      a. Individual proprietorship
      b. Corporation
    2. Semiprivate
      a. Individual proprietorship
      b. Corporation
    3. Public or daily fee
    4. Municipal and government owned
      a. Superintendent must have control
      b. Adequate budget required
  B. Parks and cemeteries
    1. Ownership
    2. Area of responsibility
  C. Commercial, industrial, and school sites
  D. Commercial ground management contractor
    1. Area of responsibility
    2. Labor and equipment
    3. Transportation
    4. Competition (efficiency of operation)
    5. Type of contract
      a. Yearly
      b. Cost-plus
      c. Time and material
  E. Budgets
    1. Supervision
    2. Labor
    3. Materials (supplies)
    4. Equipment

5. Repairs and depreciation
    a. Grounds
    b. Equipment
    c. Buildings
6. Maintenance and improvements
    a. Turf
    b. Garden areas
    c. Ornamental plant materials

III. Computations of Areas and Quantities
  A. Need
    1. Compute quantities of materials
    2. Determine costs
    3. Design, construction, and reconstruction
  B. Computation of areas
    1. Regular areas
      a. Squares
      b. Rectangles
      c. Circles
      d. Ellipses
      e. Triangles
    2. Irregular areas
      a. Triangulation
      b. Offset
      c. Means and extremes
  C. Volumes
    1. Materials
      a. Fertilizer, lime, soil conditioners, and water
      b. Rates of application
      c. Formulations
    2. Cut and fill
      a. Design and redesign
      b. Soil, sand, and traffic areas
      c. Drainage and irrigation
    3. Regular areas
    4. Irregular areas

IV. Material and Equipment Costs (Original and Replacement)
  A. Materials
    1. Fertilizers
    2. Lime
    3. Top dressing
    4. Insecticides
    5. Fungicides
    6. Herbicides
    7. Ornamental plant materials
    8. Gasoline and oil
    9. Paving
    10. Sand
  B. Equipment and tools
    1. General
      a. Trucks
        (1) Range buggies
        (2) Dump
        (3) Pickup
      b. Tractors
      c. Mowers
        (1) Gang
        (2) Greens
        (3) Tee
        (4) Rotary
        (5) General purpose
        (6) Sicklebar
        (7) Hammerknife
        (8) Vertical
      d. Fertilizer spreaders (gravity and cyclone type)
        (1) Tractor drawn
        (2) Hand propelled
      e. Disc harrow
      f. Cultipacker and roller
      g. Rotary hoe
        (1) Tractor powered
        (2) Self-propelled
      h. Seeder and drag mats
      i. Sod cutter
      j. Aerator
        (1) Fairway
        (2) Greens and tee self-propelled
      k. Soil shredder and screen
      l. Power sprayer
    2. Hand tools
      a. Shovels
      b. Rakes (several types)
      c. Turf brushes
      d. Sod lifters and tampers
      e. Shrub bed edgers
      f. Cup cutter
      g. Cup setter
      h. Greens poles
      i. Soil sampler
      j. Wheelbarrows
    3. Special equipment
      a. Pumps and motors
      b. Pipes, valves and fittings
      c. Hose
      d. Sprinkler heads
      e. Drinking fountains
      f. Drainage supplies
        (1) Tile
        (2) Screens

            (3) Cinders and crushed stone
            (4) Catch basins
    4. Shop equipment
        a. Hoists
            (1) Chain
            (2) Hydraulic
        b. Grinders
            (1) Mower
            (2) Bench
        c. Electric drill
        d. Equipment and tools for:
            (1) Welding
            (2) Painting
            (3) Plumbing
            (4) Carpentry
            (5) Mechanical repairing
            (6) Tree and shrub maintenance
    5. Office equipment and supplies (also overhead items)
        a. Desks
        b. Typewriter
        c. Accountant's calculator
        d. File cabinets
        e. Miscellaneous supplies
            (1) Letterhead stationery
            (2) Record forms
            (3) Record books, pencils, stamps, and others
    6. Specialized golf equipment
        a. Greens flags and poles
        b. Tee markers
        c. Ball washers and towels
        d. Hole cups
        e. Tee benches
        f. Storm shelters
        g. Score cards and pencils
        h. Cleat cleaners
        i. Tee directional guides

V. Labor Costs
  A. Construction and renovation
    1. Prepare time studies for procedures discussed in Turfgrass Culture and Turf Management I
    2. Variations in unit costs
        a. Labor supply
        b. Wages in each locality
        c. Union or nonunion
        d. Number of skilled persons required for operations
  B. Maintenance operations
    1. Unit costs again vary
    2. Time studies
        a. Labor
        b. Equipment
            (1) Operation
            (2) Depreciation
    3. Mowing
        a. Fairways
        b. Greens
        c. Tees
        d. Rough and minimum use areas
        e. Traps and bunkers
        f. Ornamental garden areas
        g. Clubhouse and residential grounds
        h. Sod nursery
    4. Fertilizing and liming (same as No. 3, plus woody plant materials)
    5. Disease control (same as No. 3 and No. 4)
    6. Insect and miscellaneous pest control (same as No. 3 and No. 4)
    7. Weed control (same as No. 3 and No. 4)
    8. Irrigation (same as No. 3 and No. 4)
    9. Aerating and thatch removal (same as No. 3, excluding d and e)
    10. Topdressing of greens
    11. Polling and brushing greens
    12. Trimming and edging
        a. Bunkers and traps
        b. Ornamental garden areas
        c. Clubhouse and residential garden areas
    13. Road and parking area maintenance
        a. Clean pavement
        b. Weed and cultivate adjacent planted areas
    14. Weed and prune
        a. Ornamental plantings
        b. Plant nursery
    15. Water hazards
        a. Mosquito control
        b. Muskrat control
        c. Mow and trim
    16. Tennis courts
        a. Clay (roll and lime)
        b. Turf (same as greens)
        c. Composition surface
    17. Practice putting, chipping, and driving area (same as for greens, tees, and fairways)
    18. Swimming pool
        a. Mow turf
        b. Trim, edge, and cultivate ornamental plantings
        c. Police deck and pool area

        - d. Skim surface and vacuum
        - e. Check purity and water circulation
    - 19. Collection and disposal of refuse
    - 20. Maintenance of equipment
    - 21. Maintenance and repair
        - a. Service buildings
        - b. Benches, storm shelters, bridges, fences, etc.
    - 22. Maintenance of drainage systems
        - a. Especially open ditch type
        - b. Clean catch basins
- C. Preparation of daily time sheets for foremen

VI. Overhead Costs
- A. Services
    - 1. Electricity
    - 2. Telephone
    - 3. Water
    - 4. Fuel
    - 5. Garbage removal
- B. Salaries and retainer fees
    - 1. Superintendent
    - 2. Assistant superintendent
    - 3. Secretary
    - 4. Accountant
    - 5. Technical specialists (soil analyst, horticulturist, engineer, etc.)
    - 6. Attorney
- C. General
    - 1. Taxes
    - 2. Insurances
        - a. Liability
        - b. Life
        - c. Retirement
        - d. Hospitalization
        - e. Social security
        - f. State-required compensation
            - (1) Unemployment
            - (2) Injury
        - g. Fire and catastrophe
    - 3. Office equipment and supplies
        - a. Desks
        - b. Typewriter(s)
        - c. Accountant's calculator
        - d. File cabinets
        - e. Miscellaneous supplies
            - (1) Letterhead stationery
            - (2) Record forms
            - (3) Record books, pencils, stamps, and other
        - f. Drafting table and stool
        - g. Chairs
        - h. Paper and other drafting supplies
    - 4. Depreciation costs of buildings and equipment
    - 5. Normal maintenance repairing of buildings and equipment
    - 6. Rent, mortgage, or interest payments
- D. General allowances
    - 1. Automobile expense
    - 2. Expenses for:
        - a. Conferences
        - b. Professional society membership and meetings
        - c. Educational short courses and meetings
    - 3. Trade journal subscriptions
    - 4. Residential utility costs for superintendent if required to live on site (extra compensation allowance in some cases)
    - 5. Travel and bad weather time

        Note: Costs and items listed will vary according to the scope and type of business being managed.

VII. Recordkeeping, Estimating, and Inventories
- A. Budget allowances
    - 1. Requirements vary
        - a. Depending on course
        - b. Depending on type of operation
        - c. From year to year on the same course or in the same business
    - 2. Available funds
    - 3. Degree of excellence
        - a. Expected
        - b. Obtained
    - 4. Contingency allowances
    - 5. Keep orderly records—daily to yearly
- B. Labor records
    - 1. Permanent employees
        - a. Skilled
        - b. Unskilled
    - 2. Temporary employees
    - 3. Operations
    - 4. Wages
    - 5. Supervision and training
- C. Equipment records
    - 1. Initial cost
    - 2. Depreciation
    - 3. Operation
    - 4. Maintenance and repair
    - 5. Replacement
- D. General records

1. Daily time records on various operations
2. Weekly and monthly summaries
3. Course conditions
4. Material application and procedures records
5. Weather conditions
6. Cost accounts

E. Season and yearly summary
  1. Preparation of following year's budget
  2. Substantiate past year's operations and costs

F. Estimation procedures
  1. Based on experience
  2. Sound recordkeeping
  3. Knowledge of operations

VIII. Costs, Markup, and Profit
  A. Costs
    1. Types
      a. Direct
      b. Indirect
    2. Increase output and efficiency of labor and equipment to reduce costs yet permit improved labor income by careful planning of operation
  B. Markup
    1. Based on costs
    2. Variables
      a. Volume
      b. Competition
      c. Area
      d. Need
    3. Type of business
    4. Size of business
    5. Business policies
    6. Gross or selling price
    7. Methods of calculation
  C. Profits
    1. Calculated from selling price
    2. Gross profit
    3. Net profit
    4. No standard percentage
    5. Middleman or distributor profit
    6. Percentage of wholesale profit related to percentage of retail profit
    7. Variables
      a. Volume
      b. Competition
      c. Areas
      d. Need
      e. General economy
      f. Skill and efficiency of operation

Recommended Laboratory Projects—48 hours

I. Make trips to golf courses and parks to acquaint students with various solutions to problems and operational procedures from the business standpoint (9 hours).

II. Compute areas and volumes (6 hours).

III. Based on results of problem II, determine required materials and equipment plus costs necessary to perform the operations specified (9 hours).

IV. Use the results from the preceding problems to calculate the specific man hours, labor force, and the direct labor costs required to complete the project (6 hours).

V. Use the results of the preceding problems and include all indirect costs, calculate overhead, and use results of this and all preceding problems to determine total overall cost (6 hours).

VI. Based on the total cost determined in problem V, calculate markup and determine profit desired to arrive at the amount the client pays for the completed project. *Note:* Although many superintendents do not become involved in profitmaking projects, students should have an understanding of the procedure for estimating profits (6 hours).

VII. Present figures from problems II through VI in detailed recordkeeping form; introduce an operational problem requiring the keeping of performance records (6 hours).

Texts and References

DAWSON. *Practical Lawncraft.*
MUSSER. *Turf Management.*
SUNSET. *Lawn and Ground Cover Book.*
Periodicals:
  The Golf Course Reporter
  Golfdom
  Park Maintenance
  Park and Recreation
  U.S.G.A. Journal and Turf Management

Instructional Aids

Notes from previous courses and field trips
Commercial literature obtained on field trips

WOODY PLANTS I

Hours Required

Class, 2; Laboratory, 2

Course Description

An introductory course to woody plants which are grown in nurseries for landscape purposes; and to those in the arboretums, forests, and fields in various regions of the United States.

Its objective is to provide students with a practical understanding of the characteristics of woody plants growing in the geographical area where the course is being taught so that students can relate the knowledge learned to the field of ornamental horticulture.

Students learn to identify each plant by its seasonal characteristics. The form, habit, height, spread, soil requirements, root system, flower, fruit, ecological relationship, susceptibility to insects and diseases, peculiarities, and horticultural usefulness of the common woody plants are studied, with emphasis on deciduous shrubs and small trees. Between 200 and 250 plants, in the geographic area where the course is taught, are studied.

Major Divisions

	Class Hours
I. Introduction and Scope of Course	2
II. Taxonomy	4
III. Woody Plant Life	2
IV. Grouping of Plants	2
V. Plant Material Terminology	2
VI. Plant Material Data	20
Total	32

Units of Instruction

I. Introduction and Scope of Course
  A. General importance to the field of ornamental horticulture
  B. Importance to specific areas of ornamental horticulture
    1. Botanical gardens
    2. Arboretums
    3. Arboriculture
    4. Nurseries
    5. Landscape design
    6. Landscape construction
    7. Landscape maintenance
    8. Horticultural management
      a. Small homes
      b. Private estates
      c. Public areas
      d. Highways
      e. Parks
      f. Golf courses
  C. Tools for study
    1. Library
    2. Arboretum
    3. Public and private plantings
      a. Nurseries
      b. Parks
      c. Cemeteries
      d. Private estates
      e. Factory and office buildings
  D. Testing and grade determination
    1. Biweekly quizzes
    2. Biweekly laboratory quizzes
    3. Midterm examination
    4. Specimen collection of leaves and fruit
    5. Final examination

II. Taxonomy
  A. Nomenclature of plants
    1. Scientific names
      a. Genus
      b. Species
      c. Advantages and disadvantages
    2. Common names
      a. Method of selection
        (1) Plant characteristics
        (2) Habitat
        (3) Association
        (4) Use
      b. Advantages and disadvantages
  B. Classification of woody plants
    1. Kingdom—vegetable
    2. Descending order
      a. Division
      b. Subdivision
        (1) Gymnosperms
        (2) Angiosperms
      c. Class
        (1) Monocotyledons
        (2) Dicotyledons
      d. Order
      e. Family
      f. Genus

      - g. Species
      - h. Variety

III. Woody Plant Life
  A. History and evolution
    1. Books
    2. Botanists, Linnaeus, and others
    3. Methods of naming plants, International Botanical Congress Rules
    4. Preglacial and glacial plant history
      a. Submergence
      b. Mountain uplift
      c. Volcanic action
    5. Cretaceous period
    6. Paleozoic period
    7. Tertiary period
  B. Distribution and geography
    1. Influences on plant life
      a. Longitude
      b. Latitude
      c. Altitude
      d. Mountains
      e. Plains
      f. Water areas
    2. United States
    3. Asia
    4. Europe, Asia Minor, Mediterranean
    5. Africa
    6. South America

IV. Grouping of Plants
  A. Physical structure
    1. Herbaceous
    2. Semiherbaceous
    3. Woody
  B. Form, habit, size
    1. Vines
    2. Ground covers
    3. Shrubs
    4. Trees
  C. Leaf persistence
    1. Deciduous
      a. Broadleaves
      b. Narrowleaves
    2. Evergreen
      a. Broadleaves
      b. Narrowleaves

V. Plant Material Terminology
  A. Importance of knowing terms
    1. Plant description
    2. Identification
    3. Use of keys
  B. Assignment of terms

VI. Plant Material Data
  A. Information Record for each plant studied
    1. Family
    2. Genus
    3. Common names
    4. Derivation of scientific name
    5. Ecology and native habitat
    6. Hardiness
    7. Ultimate height
    8. Ultimate spread
    9. Form and habit
    10. Texture
    11. Summer and fall color
    12. Bark
    13. Root system
    14. Soil preference
    15. Exposure preference
    16. Growth rate
    17. Season of foliage
      a. Shape
      b. Size
      c. Arrangement
    18. Season of flower
      a. Color
      b. Arrangement
      c. General description
    19. Season of fruit
      a. Type
      b. Arrangement
      c. Persistence
      d. Conservation value
      e. Color and size
    20. Cleanliness (leaf, flower, and bark shedding)
    21. Pruning and general care
      a. Terminal grower
      b. Intermediate grower
      c. Basal grower
    22. Landscape value and uses
    23. Propagation

Recommended Laboratory Projects—48 hours

I. Identify 10 to 15 plants each week by association of taxonomic terms and observation of plant characteristics. The number and sequence of plants studied will vary with the geographic and climatic conditions of the area, as well as the seasonal aspects (22 hours).

II. Identify by scientific name, plants designated in biweekly field quiz (8 hours).

III. Laboratory final examination given on field trip to local park, nursery, or area with a plant collection (2 hours).

Texts and References

WYMAN. *Shrubs and Vines for American Gardens.*
———. *Trees for American Gardens.*

Instructional Aids

2" x 2" color slides
16 mm. films
Laboratory charts and diagrams of plant characteristics
Nursery catalogs
Arboretum and plant collections

WOODY PLANTS II

Hours Required

Class, 2; Laboratory, 2

Course Description

This course is a continuation of Woody Plants I; additional trees and shrubs are studied, but major emphasis is placed on the study of broad-leaved and narrow-leaved evergreens.

A part of the course focuses on plant ecology, tracing the development of plant systems to growth environment, with emphasis on woody plant materials.

Major Divisions

	Class Hours
I. Plant Ecology	8
II. Plant Material Data	24
Total	32

Units of Instruction

I. Plant Ecology
  A. Basic concepts
  B. Application
  C. Factors influencing ecology
    1. Physiographic
      a. Soil
      b. Topography
      c. Sunny fields
      d. Hills
      e. Dales
      f. Mountains
    2. Biological
      a. Plants
      b. Parasites
    3. Climatic
      a. Air
      b. Temperature
      c. Light
      d. Moisture
  D. Plant associations
    1. Open field
      a. Shrubs
      b. Herbs
    2. Juniper hillside
      a. Trees
      b. Shrubs
      c. Herbs
    3. Gray birches
      a. Trees
      b. Shrubs
      c. Herbs
    4. Pine
      a. Trees
      b. Shrubs
      c. Herbs
    5. Oak woods
      a. Trees
      b. Shrubs
    6. Beech, maple, hemlock
      a. Trees
      b. Shrubs
    7. Hemlock ravine
      a. Trees
      b. Shrubs
    8. Streamside
      a. Trees
      b. Shrubs
      c. Herbs
    9. Pond
      a. Trees
      b. Shrubs
      c. Herbs
    10. Bog vegetation
    11. Seaside
      a. Trees
      b. Shrubs
      c. Grasses
    12. Others

II. Plant Material Data
  A. Information record for each plant studied
    1. Family
    2. Genus
    3. Common name
    4. Derivation of scientific name
    5. Ecology and native habitat
    6. Hardiness
    7. Ultimate height
    8. Ultimate spread
    9. Form and habit
    10. Texture
    11. Summer and fall color
    12. Bark
    13. Root system
    14. Soil preference
    15. Exposure preference
    16. Growth rate
    17. Season of foliage
      a. Shape

   - b. Size
   - c. Arrangement
18. Season of flower
   - a. Color
   - b. Arrangement
   - c. General description
19. Season of fruit
   - a. Type
   - b. Persistence
   - c. Arrangement
   - d. Conservation value
   - e. Color and size
20. Cleanliness (leaf, bark, or flower shedding)
21. Pruning and general care
   - a. Terminal grower
   - b. Intermediate grower
   - c. Basal grower
22. Landscape value and uses
23. Propagation

Recommended Laboratory Projects—32 hours

I. Identify 10 to 15 plants each week by association of taxonomic terms and observation of plant characteristics. The number and sequence of plants studied will vary with the geographic and climatic conditions of the area, as well as the seasonal aspects (22 hours).

II. Identify by scientific name, plants designated in biweekly field quiz. The quiz includes plants studied in Woody Plants I (8 hours).

III. Laboratory final examination given on field trip to local park, nursery, or area with a plant collection. Final examination will cover plants studied in Woody Plant I (2 hours).

Texts and References

Texts used in Woody Plants I, plus:

Bailey. *The Cultivated Conifers of North America.*

———. *Manual of Cultivated Plants.*

Instructional Aids

2" x 2" color slides
Laboratory charts and diagrams of plant characteristics
Nursery catalogs
Arboretum and plant collections

WOODY PLANTS III

Hours Required

Class, 2; Laboratory, 2

Course Description

This course concludes a series of three. It is an advanced study of plants previously considered, especially named varieties and cultivars, and of lesser known trees, shrubs, vines, and ground covers. In addition, the course aims to provide students with an understanding of plant requirements and teach them how to evaluate plant data for landscape purposes.

Major Divisions

	Class Hours
I. Plant Material in Design	8
II. Plant Material Data	24
Total	32

Units of Instruction

I. Plant Material in Design
  A. Selection of plants for landscape use
    1. Consider plant characteristics
    2. Consider seasonal changes
    3. Consider time element in plant design
  B. Effect of plant maintenance on design
  C. Effect of plant characteristics on design
    1. Form
      a. Sphere
      b. Spire
      c. Cylinder
      d. Oval
      e. Vasiform
      f. Pyramid
      g. Weeping
      h. Picturesque
    2. Texture
      a. Large-leaved plants
      b. Small-leaved plants
      c. Medium-leaved plants
    3. Color
      a. Nature
      b. Restrict use of unusual color
      c. Effect of texture on plant color
  D. Arrangement of plants in natural design
    1. Promontories
      a. Structure
      b. Basis for selection
    2. Bays
      a. Justification
      b. Create interest
      c. Mystery
      d. Distinctive character
    3. Islands
      a. Structure
      b. Placement
      c. Relation to main plantings
  E. For surface decoration
    1. Single specimen
      a. When to use
      b. Accent
    2. Group of two plants for picture value
    3. Group of three plants
      a. Unbalanced triangle
      b. Dominance
    4. Group of four plants in a staggered arrangement
    5. Group of five plants
      a. Possibility in varied use
      b. Value in planting design
    6. Mixed groups
      a. Simplicity
      b. Dominance
      c. Harmony
      d. Adaptation

II. Plant Material Data
  A. Information record for each plant studied
    1. Family
    2. Genus
    3. Common names
    4. Derivation of scientific name
    5. Ecology and native habitat
    6. Hardiness
    7. Ultimate height
    8. Ultimate spread
    9. Form and habit
    10. Texture
    11. Summer and fall color
    12. Bark
    13. Root system
    14. Soil preference
    15. Growth rate
    16. Exposure preference
    17. Season of foliage
      a. Shape
      b. Size
      c. Arrangement
    18. Season of flower

    - a. Color
    - b. Arrangement
    - c. General Description
  19. Season of fruit
    - a. Color
    - b. Arrangement
    - c. General description
  20. Cleanliness (leaf, bark, and flower shedding)
  21. Pruning and general care
    - a. Terminal grower
    - b. Intermediate grower
    - c. Basal grower
  22. Landscape value and uses
  23. Propagation
- B. Use of woody plants in landscaping

Recommended Laboratory Projects—32 hours

I. Prepare a planting plan of a foundation and a planting using various plant groupings (4 hours).

II. Prepare a planting plan of a natural area indicating structure of bays and promontories (4 hours).

III. Identify 10 to 15 plants each week by association of taxonomic terms and observation of plant characteristics (16 hours).

IV. Identify by scientific name, plants designated in biweekly field quiz. The quiz includes plants studied in Woody Plants I and II (6 hours).

V. Laboratory final examination given on field trip to local park, nursery, or area with a plant collection. Final examination will cover plants studied in Woody Plants I and II (2 hours).

Texts and References

Texts required for Woody Plants I and Woody Plants II, plus:

WYMAN. *Ground Cover Plants.*

Instructional Aids

2" x 2" color slides
16 mm. films
Arboretum and plant collections

Mathematics and Science Courses

MATHEMATICS

Hours Required

Class, 3; Laboratory, 0

Course Description

This course relates essential mathematical knowledge and skills to technical horticultural experience and practice. It begins with a study of basic mathematical processes followed by strong emphasis on algebra and trigonometry. The final unit on economics (interest, taxation, profit and loss) is included because of its relevance to the horticultural field. In teaching this course, mathematical concepts should be applied to horticultural problems. Class instruction should encourage use of a slide rule and mathematical handbook for arithmetic and trigonometric calculations.

Major Divisions

	Class Hours
I. Basic Mathematical Concepts and Operations	3
II. Basic Geometric Figures and Units of Measure	4
III. Basic Algebraic Fundamentals	10
IV. Functions and Graphs	3
V. Trigonometric Functions	3
VI. Logarithms	4
VII. Applications of Trigonometry	15
VIII. Mathematics of Investment	5
Total	47

Units of Instruction

I. Basic Mathematical Concepts and Operations
  A. The integers—positive, negative, and zero
  B. Whole numbers, fractions, and literal numbers
  C. The four fundamental operations
  D. Operations involving exponents
  E. Roots of numbers
    1. Squares and square root
    2. Cube and *n*th root
  F. Decimals and percentage
  G. Data processing
    1. Concept of electronic business data processing
    2. Applications to horticultural businesses

II. Basic Geometric Figures and Units of Measure
  A. Systems of measurement
    1. English
    2. Metric
  B. Linear and square measurement
    1. Triangles
    2. Rectangles
    3. Perimeter
    4. Trapezoids
    5. Circles
    6. Irregular areas
  C. Units of area measurement
  D. Volume measurement
    1. Solids
    2. Liquids
  E. Units of volume measurement
  F. Density of solids and liquids

III. Basic Algebraic Fundamentals
  A. Laws of algebra
  B. Basic laws for operating on literal numbers
    1. Terms, monomials, binomials, and polynomials
    2. Factoring algebraic expressions
    3. Equations and formulas
    4. Operations on equations
    5. Operations with and simplifying radicals
  C. Linear equations and their solutions
    1. Solutions of systems of two linear equations
      a. Graphical
      b. Algebraic
    2. Solution of systems of three linear equations in three unkowns
  D. Quadratic equations and their solution
    1. By factoring
    2. By completing the square
    3. By quadratic formula
  E. Rational algebraic expressions
    1. Fundamental principles
    2. Lowest common denominator and multiple
    3. Ratio
    4. Proportion
    5. Mixtures and dilutions

IV. Functions and Graphs
  A. Functions
  B. Rectangular coordinates
  C. Graphs of functions

V. Trigonometric Functions
  A. Angles
  B. The Pythagorean theorem
  C. Trigonometric functions and their values

VI. Logarithms
  A. Exponential and logarithmic functions
  B. Graphs of $y=b^x$ and $y=\log b^x$
  C. Properties of logarithms
  D. Common logarithms
  E. Reading logarithm tables and interpolation
  F. Computations using logarithms
  G. Logarithms of trigonometric functions
  H. Graphs on logarithmic paper
  I. Exponential and logarithmic equations

VII. Applications of Trigonometry
  A. Angles and angular measure
    1. The degree
    2. The radian
  B. Signs of trigonometric functions
  C. Interpretation of trigonometric tables
  D. The trigonometric functions of any angle
  E. Trigonometric solution of right triangles
  F. Vectors and triangles
    1. Vectors
    2. Application of vectors
    3. Trigonometric solution of oblique triangles
      a. Law of sines
      b. Law of cosines
  G. Applications of trigonometry in surveying

VIII. Mathematics of Investment
  A. Principal and interest
    1. Simple interest
    2. Compound interest
  B. Mortgages
  C. Installment buying
  D. Loans
  E. Profit and loss
  F. Taxes
  G. Discount
  H. Commission or brokerage

Texts and References

TUITES. *Basic Mathematics for Technical Courses.*
WASHINGTON. *Basic Technical Mathematics.*

BOTANY

Hours Required

Class, 3; Laboratory, 3

Course Description

This course teaches the basic structure of plant life. Plant nomenclature is studied early in the course, followed by a study of botanical terminology, and the function of each plant organ. Cell structure, cell division, the physiological processes of plant life—osmosis, respiration, transpiration, photosynthesis, metabolism, and reproduction—are discussed; and the principles of genetics and plant breeding are introduced. Students learn to use the microscope for laboratory study of cell structure and plant anatomy. Classroom work is accomplished through lectures and use of visual aids.

Major Divisions

		Class Hours
I.	Introduction	2
II.	Plant Classification	2
III.	Cytology—the Study of Cells	4
IV.	Physiology of the Cell	4
V.	The Root	2
VI.	The Leaf	3
VII.	Photosynthesis and Respiration	3
VIII.	The Stem—External and General Structure	3
IX.	Internal Anatomy of Stems	3
X.	Infloresence	3
XI.	Fruit and Seed Dispersal	2
XII.	Seed and Seed Germination	2
XIII.	Cell Division	2
XIV.	Genetics	4
XV.	Mycology	5
XVI.	Mosses and Lichens	2
XVII.	Ferns and Club Mosses	2
	Total	48

Units of Instruction

I. Introduction
  A. Definition of botany
    1. Importance to world
    2. Basic need for food
    3. Basis for horticulture
  B. Plants compared to animals
    1. Motion
    2. Food procurement
    3. Cell division
    4. Major systems
  C. Origin of plants

II. Plant Classification
  A. Need for classification
    1. Old systems
    2. Linnaeus's binomial system of nomenclature
    3. The traditional system
    4. Newer natural systems

III. Cytology—the Study of Cells
  A. History
    1. Hooke and cork cells
    2. Wolff's Cell Theory
    3. Dujardin—identified cell contents
    4. Von Mohl—protoplasm
  B. Cell structure
    1. Size
    2. Shape
    3. Parts of a typical cell
      a. Cytoplasm
        (1) Hyaloplasm
        (2) Organelle
          (a) Plastids
          (b) Mitochrondria
          (c) Ribosomes
          (d) Others
        (3) Cell membranes
          (a) Tonoplast
          (b) Ectoplast
      b. Nucleus
        (1) Key to cell and life
        (2) Reticulum
        (3) Nucleoli
        (4) Karyolymph
      c. Ergastic substances in vacuoles
        (1) Dissolved nutrients, sugars, acids
        (2) Gases
        (3) Starch crystals
        (4) Stored wastes
      d. Cell wall
        (1) Nature
        (2) Structure
        (3) Inclusions
  C. Nature of protoplasm
    1. Physical nature

        2. Chemical nature
        3. Properties
    D. The thread of life—DNA (deoxyrinucleic acid)
        1. Chemical nature—4 bases
        2. Molecular structure, the Watson-Crick model
        3. DNA's action
            a. Replication
            b. Relation to RNA (ribonucleic acid)
            c. Building of proteins
        4. Nirenberg's work with "Poly U"
        5. Ramifications of DNA-RNA study
            a. Memory
            b. Heredity defects
            c. Relation to viruses
            d. Relation to cancer

IV. Physiology of the Cell
    A. Osmosis
        1. Membrane systems, the ectoplas-tonoplast relation
        2. Relation to diffusion
        3. Turgidity and flaccidity of cells
        4. Explanation of osmotic movement
        5. Plasmolysis
            a. Extreme endosmosis
            b. Relation to fertilizer and spray injury
    B. Transpiration
        1. Definition
        2. Early hypotheses
        3. Joly-Dixon theory
        4. Water loss by plants
        5. Factors affecting transpiration
            a. Temperature
            b. Light
            c. Humidity
            d. Wind
            e. Leaf structure

V. The Root
    A. Functions
    B. The soil and its effect on plants
        1. Air—oxygen
            a. Aeration-soil types
            b. Compaction
        2. Water content
            a. Types of water
                (1) Capillary action
                (2) Root absorption of nutrients
                (3) Capillary movement
                    (a) Cultivation
                    (b) Mulches
            b. Available water for plants
        3. Rock particles
            a. Physical nature of soil
            b. Clays, silts, sand
        4. Minerals
            a. Rock disintegration
            b. Basis for fertilizers
            c. C HOPKINS Ca Fe Mg
        5. Organic matter
            a. Sources
            b. Value
            c. Humus compared to peat
        6. Microorganisms
            a. Fungi
            b. Insects
            c. Earthworms
            d. Mycorrhiza
            e. Bacteria
    C. Effect of plants on soil
        1. Absorb nutrients
        2. Plant wastes supply organic matter
        3. Erosion control
    D. Origin of roots
    E. Types of roots
        1. Fibrous and taproots
        2. Rootlets and roothairs
        3. Zones of rootlets
    F. Internal structure of roots
        1. Young dicot root tissues
        2. Mature dicot root tissues
        3. Dicot compared to monocot roots
    G. Modified roots
        1. For storage
        2. Parasitic roots
        3. Saprophytes
        4. Adventitious roots
            a. Support
            b. Propagation
            c. Pneumatophores
            d. Absorption food and water

VI. The Leaf
    A. Origin
    B. Phyllotaxy—leaf arrangement—alternate, opposite, whorled
    C. Persistence of leaves—evergreen and deciduous
    D. Terminology of leaves
    E. Venation, types, net, and parallel
    F. Simple and compound leaves
    G. Functions of leaves
        1. Photosynthesis
        2. Transpiration

    - 3. Protection
    - 4. Attraction insects
- H. Leaf adaptations
    - 1. To light
    - 2. To water
    - 3. To absorption of nutrient and water
    - 4. To storage
    - 5. For protection
    - 6. For reproduction
    - 7. Carnivorous plants
        - a. Active traps
        - b. Passive traps

- I. The stoma
    - 1. Structure
    - 2. Operations
    - 3. Factors affecting stomatal activity
- J. Modified leaves
    - 1. Bracts
    - 2. Spathes
- K. Internal structure
    - 1. Photosynthetic area
    - 2. Vein system
- L. Fall color and leaf drop
- M. Guttation

VII. Photosynthesis and Respiration
- A. Definition
- B. Formula for reaction
- C. Chlorophyll
    - 1. Nature and properties
    - 2. Chemical structure
    - 3. Adenosine triphosphate (ATP) and photosynthesis
- D. Nature of light, photoperiodism
- E. Factors affecting rate of photosynthesis
- F. Respiration
    - 1. Definition
    - 2. Metabolism
        - a. Anabolism
        - b. Catabolism
    - 3. Stages in process
        - a. Glycolysis
            - (1) Phosphorylation
            - (2) Cleavage of sugar
            - (3) Formation of pyruvic acid
        - b. Aerobic and anaerobic respiration
        - c. Organic acid cycle (Krebs cycle)
    - 4. Factors affecting respiration

VIII. The Stem—External and General Structure
- A. Orgin of stem
- B. Functions of stems
- C. Types of stems
    - 1. Woody
    - 2. Herbaceous
- D. Stem features
    - 1. Color
    - 2. Shape
    - 3. Buds
        - a. Arrangement
        - b. Position
        - c. Composition
    - 4. Nodes and internodes
    - 5. Lenticels
    - 6. Scars
        - a. Significance
        - b. Cause
    - 7. Modified stems
        - a. Climbing
        - b. Protective—the thorn series
        - c. Storage
        - d. Reproduction
        - e. Horizontal and underground stems
            - (1) Stolon
            - (2) Rhizome
            - (3) Tuber
            - (4) Corm
            - (5) Bulb

IX. Internal Anatomy of Stems
- A. Stem tissues
    - 1. Meristematic
        - a. Protoderm
        - b. Procambium
        - c. Ground meristem
    - 2. Primary and secondary tissues
    - 3. Permanent stem tissues
        - a. Simple
            - (1) Epidermis
            - (2) Parenchyma
            - (3) Sclerenchyma
            - (4) Collenchyma
            - (5) Phellem
        - b. Complex
            - (1) Xylem
            - (2) Phloem
- B. Evolution of stems
    - 1. Coniferous softwood gymnosperm—pine
        - a. Structure
        - b. Features
    - 2. Woody dicot stem—hardwood
        - a. Angiosperm—oak
        - b. Oak compared to pine
        - c. The linden—*Tilia* (basswood)

3. Herbaceous dicot stem, sunflower
    a. Woody compared to herbaceous dicot
    b. Structure, simplicity
    c. Annual, biennial, perennial concept
4. Herbaceous monocot stem, corn
    a. Sunflower compared to corn stem
    b. Extreme modification
    c. Significance

C. Tropisms
  1. Types
  2. Importance

D. Phytohormones
  1. Importance
  2. Applied uses

X. Infloresence
  A. Origin of flower
  B. Floral anatomy
    1. Accessory compared to necessary flower parts
    2. Basic flower parts
      a. Petals (corolla)
      b. Sepals (calyx)
      c. Stamens (androecium)
      d. Pistils (gynoecium)
      e. Receptacle (torus)
      f. Peduncle
    3. Petaloid
    4. Flower types (inflorescence)
    5. Perfect and imperfect flowers
      a. Monoecious
      b. Dioecious
    6. Pollination
      a. Self-pollination
      b. Cross-pollination
        (1) Wind
        (2) Water
        (3) Insect
    7. The ovary
      a. Types—superior, inferior, half-inferior
      b. Epigynous, perigynous, and hypogynous arrangement
    8. The ovule
      a. Types of placentation
      b. Ovule position

XI. Fruit and Seed Dispersal
  A. Macrosporogenesis
  B. Microsporogenesis
  C. Development of the ovule
  D. Fruit-mature ovary
  E. Classification of fruits
    1. Simple
      a. Dry fruits
        (1) Dehiscent
          (a) Follicle
          (b) Legume
          (c) Capsule
          (d) Silique
          (e) Pyxix
        (2) Indehiscent
          (a) Achene
          (b) Caryopsis
          (c) Samara
          (d) Nut
          (e) Schizocarp
      b. Fleshy fruits
        (1) Drupe
        (2) Pome
        (3) Berry
    2. Aggregate fruits
    3. Multiple fruits
    4. Accessory fruits
  F. Dispersal of seeds
    1. Winged seeds
    2. Plumed seeds
    3. Spiny or barbed seeds
    4. Water dispersed
    5. "Nuts" planted by squirrels
    6. Explosive seeds
    7. Edible fruits—seeds pass through digestive system

XII. Seed and Seed Germination
  A. Definition of a seed
  B. Anatomy of seeds
  C. Germination of seeds
    1. Epigean type
    2. Hypogean type
    3. Advantages of each
  D. Seed storage
  E. Factors in seed germination
    1. Water
    2. Oxygen
    3. Proper temperature
    4. Good seed
    5. Dormancy
      a. Methods of breaking dormancy
        (1) Scarification
        (2) Stratification
        (3) After-ripening
      b. Length of periods of dormancy

XIII. Cell Division
  A. Mitosis
    1. Definition

    2. Occurrence
    3. Purpose
    4. Phases
  - B. Meiosis
    1. Definition
    2. Occurrence
    3. Purpose
    4. Phases
    5. Comparison with mitosis

XIV. Genetics
  - A. History
  - B. Gregor Mendel's laws of heredity
  - C. Exceptions
  - D. Applications to plant breeding

XV. Mycology
  - A. Definitions and terminology
  - B. Four groups of fungi
    1. Phycomycetes—algal fungi, water molds
       - a. Structure
       - b. Sexual reproduction
       - c. Asexual reproduction
       - d. Diseases caused
    2. Ascomycetes—sac fungi
       - a. Structure
       - b. Sexual reproduction
       - c. Asexual reproduction
       - d. Diseases caused
    3. Basidiomycetes
       - a. Structure
         - (1) Homobasidiomycetes—mushrooms, puffballs, wood fungi
         - (2) Heterobasidiomycetes—rusts, smuts
       - b. Sexual reproduction
       - c. Asexual reproduction
       - d. Diseases caused
    4. Deuteromycetes (fungi imperfecti)
       - a. Structure
       - b. No known sexual stage
       - c. Asexual stage
       - d. Diseases caused
  - C. Bacteria
    1. Types—rod-type only plant pathogenes
    2. Structure and terminology
    3. Reproduction
    4. Diseases caused
  - D. Viruses
    1. Definition
    2. Diseases caused

XVI. Mosses and Lichens
  - A. Phylum Bryophyta
    1. Structure
    2. Reproduction—sexual and asexual
    3. Importance
  - B. Classes

XVII. Ferns and Club Mosses
  - A. Phylam Pteridophyta—class Filicineae
    1. Structure
    2. Reproduction—sexual and asexual
    3. Importance
  - B. Comparison with mosses

Recommended Laboratory Projects—48 hours

I. Study the microscope and plant as a whole (3 hours).
  - A. Types of microscopes
  - B. Theory of the compound monocular scope
  - C. Nomenclature and rules for operation
  - D. Practice use of binocular stereoscope
  - E. Practice use of compound microscope
  - F. Plant as a whole—the buckwheat (make drawings)
    1. The four organs
       - a. Root
         - (1) Functions
         - (2) Grass structure
       - b. Stem
         - (1) Functions
         - (2) Grass structure
       - c. Leaf
         - (1) Functions
         - (2) Grass structure
       - d. Flower
         - (1) Functions
         - (2) Parts
    2. Herbaceous compared to woody plants
       - a. Annuals
       - b. Perennials
       - c. Biennials
  - G. Label drawings

II. Examine cells and make drawings (3 hours).
  - A. Typical large dead cell—elder and pith cell
    1. Shape
    2. Purpose
    3. Structure
  - B. Living epidermal cell—onion skin
    1. Shape
    2. Purpose
    3. Structure
    4. Comparisons
    5. Staining with iodine

- C. Cyclosis—*Elodea* or *Vallisneria* leaves
    - 1. Note apparent chloroplast movement
    - 2. Cytoplasmic streaming
    - 3. Spur-thorn cells
- D. Algal cells—spirogyra and other algae
    - 1. Spiral chloroplasts
    - 2. Pyrenoids
- E. Structure of typical cell
- F. Label drawings

III. Study the leaf and make drawings (3 hours).

- A. Dicot leaf—lilac
    - 1. Leaf tissues and anatomy
    - 2. Venation system
- B. Monocot leaf—corn
    - 1. Leaf tissues and anatomy
    - 2. Venation system
    - 3. Dicot *vs.* monocot leaf
- C. The stoma—lily epidermal cells
    - 1. Distribution of stomata
    - 2. Purpose
    - 3. Operation of stoma
- D. Leaf terminology
    - 1. Shapes
    - 2. Tips
    - 3. Bases
    - 4. Margins
    - 5. Surfaces
    - 6. Simple and compound
    - 7. Venation
    - 8. Evergreens
- E. Dichotomous keys
    - 1. Purpose
    - 2. Formation
    - 3. Use
- F. Label drawings

IV. Study roots, and root systems, and make drawings (6 hours).

- A. Origin of roots
- B. Types of root systems
- C. Zones of a rootlet
- D. Root functions
- E. Internal anatomy
    - 1. Young dicot root—buttercup
        - a. Tetrarch xylem
        - b. Other tissues
    - 2. Mature oak root
        - a. Comparisons
        - b. Tissues
    - 3. Young monocot root—lily
        - a. Polyarch xylem
        - b. Other tissues
        - c. Comparison with young dicot
    - 4. Corn root, monocot, extreme development of xylem
- F. Origin of root tissues
- G. Adventitious roots
- H. Label drawings

V. Examine external and modified stems and make drawings (3 hours).

- A. Gross anatomy of horsechestnut stem
    - 1. Buds, types: terminal, axillary, dormant
        - a. Arrangement: alternate, opposite, whorled
        - b. Composition: vegetative, reproductive, mixed
        - c. Structure: scaly (valvate, imbricate) and naked
    - 2. Scars
        - a. Leaf scars
        - b. Leaf trace scars (vascular bundle scars)
        - c. Significance of girdle or growth scars
    - 3. Lenticels
        - a. Structure
        - b. Purpose
- B. Dissection of terminal horsechestnut bud
    - 1. Note ways bud is protected. Why?
    - 2. Note bud structure
    - 3. Vegetative or mixed bud
- C. Modified stems
    - 1. Stolon, rhizome, tuber series
    - 2. Corms
    - 3. Bulbs
- D. Thorn series
    - 1. Apple thorn
    - 2. Hawthorn thorn
    - 3. Honey locust thorn
    - 4. Barberry thorn
    - 5. Black locust thorn
    - 6. Rose thorn
- E. Label drawings

VI. Study gross and internal anatomy of the woody stem; make drawings (3 hours).

- A. Coniferous softwood—gymnosperm (pine)
    - 1. Study of pine blocks cut three ways
    - 2. Compare with similar oak blocks
    - 3. Nature of pith. Why?
    - 4. Tissues of a soft wood stem—microscopic view
    - 5. Resin and its importance

    6. Characteristics of softwoods
    7. Study of xylem—the tracheid
        a. Transverse view
        b. Radial view
        c. Tangential view
    8. Study of pine ray
        a. Transverse view
        b. Radial view
        c. Tangential view
  B. Label drawings

VII. Study internal anatomy of hardwood dicot, herbaceous dicot, and monocot stem; make drawings (3 hours).
  A. Microscopic study of oak stem; compare with pine
  B. Microscopic study of basswood stem
    1. Comparisons with pine and oak
    2. Note sieve tubes, vessels, compound diffuse rays
  C. Characteristics of hardwood dicot stem
  D. Herbaceous dicot stem
    1. Microscopic study of sunflower stem
    2. Note features of this herbaceous stem
  E. Herbaceous monocot stem
    1. Microscopic study of corn stem
    2. Compare with sunflower stem
  F. Characteristics of herbaceous stem
  G. Trace evolution of monocot stem (corn)
  H. Label drawings

VIII. Study the flower—rose; make drawings (3 hours).
  A. Accessory flower parts
    1. Sepals—purpose
    2. Petals—purpose
  B. Essential flower parts
    1. Gynoecium: pistils—female organ, detailed structure of ovary and ovule
    2. Androecium: stamens—male organ
        a. Study of stamen and anther
        b. Study of pollen grains
  C. Other flower parts
    1. Torus—receptacle
    2. Peduncle
  D. Pollination and fertilization of flowers
  E. Label drawing

IX. Study the flower (continued, 3 hours).
  A. Complex flowers—petunia, lily, anthurium, snapdragon, sweet pea
  B. The composite flower—chrysanthemum or sunflower (ray florets and disc florets)
  C. Perfect, monoecious, and dioecious flowers
  D. Ovary types
  E. Ovule placentation
  F. Label drawing

X. Examine seeds and study seed germination; make drawings (3 hours).
  A. Castor bean seeds
    1. Anatomy and structure
    2. Germination
  B. Garden bean seeds and seedlings
    1. Anatomy and structure
    2. Germination
    3. Comparisons with castor bean
  C. Garden pea seeds and seedlings
    1. Anatomy and structure
    2. Germination
    3. Comparisons with castor bean and garden bean
  D. Corn kernel and seedlings
    1. Anatomy and structure
    2. Germination
    3. Comparisons with all three
    4. Monocot compared to dicot seeds
  E. Factors in seed germination
  F. Seed storage
  G. Special problems in seed germination
  H. Label drawings

XI. Investigate genetics (3 hours).
  A. Mitosis and meiosis study—onion root tip
  B. Mendel's principles and application
  C. Use of Punnett squares
  D. The monohybrid dominant cross 3:1 ratio
  E. The dihybrid dominant cross 9:3:3:1 ratio
  F. The trihybrid dominant cross 27:9:9:9:3:3:3:1 ratio
  G. Incomplete dominance one, two, and three factors

XII. Study examples of genetics applications (3 hours).
  A. Exceptions to Mendel's laws
    1. Factor interaction
    2. Epistasis
    3. Linkage
    4. Duplicate factors
    5. Multiple alleles
  B. The backcross and testcross
  C. Mutation
    1. Natural
    2. Induced
    3. Somatic
    4. Genic
    5. Chimeras

XIII. Study mycology (6 hours).
- A. Bacteria
  - 1. Types
  - 2. Reproduction
  - 3. Diseases
- B. Phycomycetes
  - 1. Structure
  - 2. Reproduction
  - 3. Diseases
- C. Ascomycetes
  - 1. Structure
  - 2. Reproduction
  - 3. Diseases
- D. Basidiomycetes
  - 1. Rusts and smuts, life cycles
  - 2. Mushrooms
    - a. Anatomy
    - b. Value
  - 3. Wood rotting fungi
- E. Deuteromycetes (fungi imperfecti)
  - 1. Structure
  - 2. Asexual reproduction
  - 3. Diseases
- F. Viruses
- G. Physiopaths

XIV. Study the lichens, mosses, and ferns (3 hours).
- A. Lichens
  - 1. Definition
  - 2. Structure
  - 3. Importance
- B. Mosses
  - 1. Definition
  - 2. Structure
  - 3. Reproduction
  - 4. Importance
- C. Ferns
  - 1. Definition
  - 2. Structure
  - 3. Reproduction
  - 4. Importance

Texts and References

CRONQUIST. *Introductory Botany.*
FULLER *and* CAROTHERS. *The Plant World.*
FULLER *and* TIPPO. *College Botany.*
MULLER. *Botany.*
ROBBINS *and* others. *Botany.*
SINNOTT *and* WILSON. *Botany.*
WEISZ *and* FULLER. *The Science of Botany.*

Instructional Aids

2" x 2" Kodachrome slides
16 mm. films
Dissecting kit
Laboratory wall charts and diagrams
Herbarium specimens
Other preserved and dried visual plant material

CHEMISTRY

Hours Required

Class, 3; Laboratory, 3

Course Description

This course reviews general inorganic chemistry and introduces organic and biological chemistry as applied to the horticultural field.

The laboratory exercises have been chosen to provide basic skills in handling equipment and chemicals. The experimentation enhances the lecture material and stresses applications to the horticultural field. The student is introduced to objective observation, accurate note taking and reporting, and safety practices in handling chemicals and equipment. Films and other instructional aids are employed to vary the approach to subject matter and provide stimulation throughout the course.

Major Divisions

	Class Hours
I. Review of the Metric System	3
II. Chemical Symbols and the Elements	3
III. Chemical Bonds and Valence	4
IV. Physical and Chemical Properties	3
V. Solutions	3
VI. Ionization	6
VII. Chemical Reactions	4
VIII. Colloids	3
IX. Basic Organic Compounds	5
X. Carbohydrates	3
XI. Lipids	2
XII. Amino Acids and Proteins	4
XIII. Nucleo-Proteins	2
XIV. Enzymes	3
Total	48

Units of Instruction

I. Review of the Metric System
  A. Decimal System
  B. Exponents
  C. Units of length
  D. Volume and weight relationships, and units
  E. The temperature scales

II. Chemical Symbols and the Elements
  A. Atomic structure and particles
  B. Atomic number and weights
  C. Compounds
    1. Law of definite proportion
    2. Formula and formula weights
    3. Percent composition

III. Chemical Bonds and Valence
  A. Ionic bonds
  B. Covalent bonds
  C. Hydrogen bonds
  D. Valence theory

IV. Physical and Chemical Properties
  A. Physical and chemical changes
  B. Heat of solution
  C. Heat of reaction
  D. Particle size and solubility

V. Solutions
  A. Definition and components of a solution
  B. Percentage solution
  C. Saturated and supersaturated solutions
  D. Molar and normal solutions
  E. Dilutions

VI. Ionization
  A. Ionization of water; the *p*H scale
  B. Measurement of *p*H
  C. Acids, bases, and salts
  D. Common ions
  E. Water hardness and water conditioning

VII. Chemical Reactions
  A. Reaction kinetics
  B. Equilibrium
  C. Neutralization reactions
  D. Oxidation-reduction
  E. Reactions of acids, bases, and salts

VIII. Colloids
  A. Particle size and surface activity
  B. Suspensions and emulsions
  C. Modified suspensions and emulsions
  D. Emulsifying agents
  E. Dialysis and precipitation of colloids

IX. Basic Organic Compounds
  A. The carbon atom
  B. Aliphatic and aromatic hydrocarbons
  C. Organic functional groups
    1. Organic halogen compounds
    2. Alcohols and ethers
    3. Acids, aldehydes, and ketones

    - 4. Amides and amines
  - D. Organic reaction

X. Carbohydrates
  - A. Photosynthesis
  - B. Structure and nomenclature of carbohydrates
  - C. Classification of carbohydrates
  - D. Optical activity

XI. Lipids
  - A. Structure and occurrence of lipids
  - B. Compound lipids
  - C. Essential oils
  - D. Plant pigments

XII. Amino Acids and Proteins
  - A. Different forms of nitrogen
  - B. Utilization of nitrogen in plants
  - C. Structure and nomenclature of amino acids
  - D. Protein structure, the peptide bond
  - E. Classification of proteins

XIII. Nucleo-Proteins
  - A. Composition of nucleo-proteins
  - B. Function of nucleo-proteins in biological systems
  - C. The structure of RNA and DNA

XIV. Enzymes
  - A. Nature and function of enzymes
  - B. Influences in enzyme activity
  - C. Digestion
  - D. Vitamins and hormones

Recommended Laboratory Projects—48 hours

I. Basic techniques (3 hours).
  - A. Orientation in the laboratory
  - B. Use of measuring devices
    - 1. Eyedropper
    - 2. Measuring and volumetric pipettes
    - 3. Burette
    - 4. Graduated cylinder
    - 5. Volumetric flask

II. Basic techniques (3 hours).
  - A. Use of trip and torsion balance
  - B. Use of gas burner
  - C. Determination of organic matter content in soil by combustion of an air dried sample
  - D. Density and specific gravity

III. and IV. Chemical and physical changes; reactions (6 hours).
  - A. Positive heat of solution
  - B. Endothermic reaction
  - C. Percentage solution; dilutions
  - D. Reactions between salts
  - E. Reactions of metals and salts with acids
  - F. Reactions of bases with acids

The student carries out a number of basic chemical reactions. He observes the difference between a physical change and a chemical reaction. Filtration, use of a thermometer, and the preparation of a solution with a followed dilution increases his skill.

V. and VI. Solutions (6 hours).
  - A. Solubility and solvents
  - B. Particle size and solubility
  - C. Saturated and supersaturated solutions
  - D. Molar and normal solutions
  - E. Titration

By use of various solvents, as well as some organic and inorganic compounds, the student determines in these laboratories the rate of solubility of some compounds. The influence of temperature and particle size is measured in a time study. The student prepares a number of molar and normal solutions and carries out several titrations; calculation of titration results.

VII. and VIII. Electrolytes (6 hours).
  - A. Ionization and conductivity
  - B. Qualitative analysis
  - C. Hydrogen-ion concentration
  - D. Color indicators
  - E. Potentiometer

The student measures conductivity in solution and determines *p*H values by colorimetric and potentiometric procedures. Qualitative and semiquantitative testing of soils by the student on soil samples is used here to promote observations and evaluations by the student. The use of a blank determination is introduced.

IX. Acid-base reactions (3 hours).
  - A. Acid-base titration
  - B. Determination of total active and reserve acidity

This laboratory is used for quantitative determination of acidity by titration. Use of indicators and potentiometer for titration. The total acidity of various soil samples is determined by the student. Calculation and correlation of data.

X. Colloidal studies (3 hours).
- A. Properties of colloids; the Tyndal effect
- B. Surface activity
- C. Precipitation of a colloid
- D. Protective action of a colloid
- E. Colloidal components of soils

The student observes the properties and behavior of colloids. He evaluates the action and presence of colloids in the soil and measures ion-exchange capacity of soils.

XI. Organic compounds (3 hours).
- A. Comparison or inorganic and organic compounds
- B. Organic solvents
- C. Preparation of an ester
- D. Preparation of aspirin

The choice of experiments is made on the basis of semimicro operations. Emphasis is on the solvent power of organic solvents. The preparation of some esters and aspirin are examples of some organic reactions.

XII. Carbohydrates (3 hours).
- A. General test for carbohydrates
- B. Benedict and Seliwanoff tests
- C. Iodine test for starches
- D. Acid hydrolysis of starch

This exercise covers some tests for carbohydrates. The student prepares starch from potatoes and checks the breakdown of that starch by acid hydrolysis in a time study.

XIII. Lipids (3 hours).
- A. The acrolein test
- B. Iodine test for unsaturated fats
- C. Preparation of soap
- D. Free fatty acids from soap
- E. Fat solvents

In this exercise the student checks the solubility of fatty substances in various solvents. Some general tests and the breakdown of a fat by base hydrolysis are performed.

XIV and XV. Amino acids and proteins (6 hours).
- A. Ninhydrin test
- B. Burrette test
- C. Physical properties of proteins
- D. The Kjeldahl test
- E. Separation of amino acids by paperchromatography

General and specific tests on amino acids and proteins are performed by the student. A complete analytical determination for nitrogen content of proteins or other nitrogen organic compounds is performed by the student.

XVI. Enzymatic studies (3 hours).
- A. Reaction of invertase on sucrose
- B. Reaction of lipase on fats
- C. Reaction of protease on gelatin
- D. Reaction of rennin on milk
- E. Reaction of saliva on starch

These enzymatic studies make the student aware of the powerful action of enzymes. The control of conditions such as temperature, *p*H and activators is observed by the student in these studies. Results are checked by visual observations or by previously used chemical tests.

Texts and References

CRAFTS. *The Chemistry and Mode of Action of Herbicides.*
DONAHUE. *Soils.*
ESTOK. *Organic Chemistry, a Short Course.*
HOLUM. *Elements of General and Biological Chemistry.*
ROUTH. *Fundamentals of Inorganic, Organic and Biological Chemistry.*
WATT *and* others. *Chemistry in the Laboratory.*
Selected readings from *Scientific American.*

Instructional Aids

Selected films from the Baxter Chemistry Series
Overhead projection slides

ENTOMOLOGY AND PLANT DISEASE CONTROL

Hours Required

Class, 2; Laboratory, 2

Course Description

This course provides a basic understanding of insects and diseases that attack ornamental plant materials and turfgrasses. The nature, structure, and important functions of body parts; the growth, habits, injurious effects, and life cycle of various plant insects are studied in detail. Pesticides, their uses, limitations, and methods of application, are discussed with emphasis on safety.

This course is taught by lectures and laboratory study with microscopics, charts, and demonstrations. Clasroom discussion and field study supplement the lectures and indoor laboratory sessions.

Major Divisions

	Class Hours
I. Course Introduction and the Pest Control Program	2
II. History of Plant Protection from Insects	4
III. Parts of Insects	4
IV. Insect Metamorphosis and Internal Anatomy	4
V. Insect Classification	3
VI. Nematodes	2
VII. Insect Control	4
VIII. Fungicides and Fumigation	2
IX. Plant Diseases and Controls	4
X. Weed Identification and Control	3
Total	32

Units of Instruction

- I. Course Introduction and the Pest Control Program
  - A. Introduction
    - 1. The field of entomology
    - 2. Importance in horticulture
  - B. The pest control program
    - 1. Scope
    - 2. Ramifications
- II. History of Plant Protection from Insects
  - A. Changes in last 100 years
  - B. Reasons for increased protection
  - C. Crop losses
    - 1. From insects
    - 2. From disease
  - D. Effects of insects on:
    - 1. Man
    - 2. Domestic animals
    - 3. Crops
    - 4. Property
  - E. Insects as disease vectors
- III. Parts of Insects
  - A. Mouth parts
    - 1. Chewing
    - 2. Piercing
    - 3. Sucking
    - 4. Other
  - B. External parts
    - 1. Exoskeleton
    - 2. Legs
    - 3. Wings
  - C. Main units
    - 1. Head
    - 2. Thorax
    - 3. Abdomen
- IV. Insect Metamorphosis and Internal Anatomy
  - A. Metamorphosis
    - 1. Life cycles
    - 2. Histories
    - 3. Simple
    - 4. Gradual
    - 5. Complete
  - B. Internal anatomy systems
- V. Insect Classification
  - A. Classification
  - B. Forms related to insects
    - 1. In other phyla
    - 2. In other classes
- VI. Nematodes
  - A. Classification
  - B. Life history
  - C. Description
  - D. Control
- VII. Insect Control
  - A. Types and importance
  - B. Insecticides
    - 1. Legal aspects
    - 2. Miller Bill
    - 3. Types

- 4. Uses
- C. Pesticide equipment
    - 1. Sprayers
    - 2. Dusters
    - 3. Systemic
    - 4. Fumigant applicators
- VIII. Fungicides and Fumigation
  - A. Fungicides
    - 1. Action
    - 2. Use
  - B. Fumigation
    - 1. Soil
    - 2. Air
    - 3. Greenhouse aerosols
- IX. Plant Diseases and Controls
  - A. Symptoms of plant diseases
  - B. Important diseases
    - 1. Of trees
    - 2. Of shrubs
    - 3. Of herbaceous plants
    - 4. Of roses
    - 5. Of turf
  - C. Controls
    - 1. Fungicides
    - 2. Fumigation
    - 3. Management
- X. Weed Identification and Control
  - A. Weeds
    - 1. Types
    - 2. Importance
  - B. Control
    - 1. Herbicides
    - 2. Management
    - 3. Manual

Recommended Laboratory Projects—32 hours

- I. Examine external structure of insects (4 hours).
  - A. Grasshopper
  - B. Cicadas, beetles, and scales
- II. Examine mouth parts of insects (4 hours).
  - A. Chewing, piercing, and sucker types
  - B. Other types
- III. Examine metamorphosis and anatomy (4 hours).
  - A. Metamorphosis
  - B. Internal anatomy of a grasshopper (dissect)
- IV. Prepare a key of insect orders (6 hours).
  - A. Classification and identification
  - B. Forms related to insects
    - 1. Mites, ticks, spiders, sowbugs, centipedes and millipedes
    - 2. Slugs, snails, nematodes, and (other) plant-harmful mammalia
- V. Study symptoms of plant disease (2 hours).
- VI. Study insecticides (4 hours).
  - A. Labeling laws
  - B. Types and uses
- VII. Field study (8 hours).
  - A. Insects
  - B. Diseases
  - C. Weeds

Texts and References

COUCH. *Diseases of Turfgrasses.*

LITTLE. *General and Applied Entomology.*

METCALF *and* others. *Destructive and Useful Insects.*

PYENSON. *Elements of Plant Protection.*

U.S. DEPARTMENT OF AGRICULTURE. Miscellaneous Publication 626. *Handbook of Section Enemies of Flowers and Shrubs.*

Instructional Aids

2" x 2" slides
Laboratory charts and diagrams
Insect, disease, and weed specimens

HORTICULTURAL SCIENCE

Hours Required

Class, 2; Laboratory, 6

Course Description

This course is a study of the environmental forces which affect the living plant in active growth or in a state of rest. The whole range of horticultural plant products is considered from the germination of annuals through the pruning of both fruit-bearing and nonfruit-bearing ornamental woody perennials. Most of the laboratory work is devoted to the theory and practices of plant propagation.

Because of its diversity the course has three major units. All parts are developed simultaneously through lectures and assignments in text and selected references on theory, and the application of theory in the laboratory.

This course is preceded by introductory botany and chemistry which provide the scientific principles required for theoretical and applied horticultural science.

Major Divisions

	Class Hours
I. Plant Development	8
II. Forces Affecting Plant Development	12
III. Application of Theory	12
Total	32

Units of Instruction

- I. Plant Development
  - A. Germination
    - 1. Mechanics of germination
    - 2. Forces affecting germination
      - a. Seed dormancy
      - b. Seed coat
      - c. Internal breaking of dormancy
  - B. Juvenility
    - 1. Presence of juvenility
    - 2. Forces affecting juvenility
      - a. Retention and loss of juvenility
      - b. Physiological factors affecting cell structure
  - C. Maturity
    - 1. Presence of maturity
    - 2. Forces inducing maturity
  - D. Bud differentiation
    - 1. Mechanics of change
    - 2. Forces causing change
      - a. Carbon to nitrogen ratio (C/N)
      - b. Photoperiod
      - c. Vernalization
      - d. Temperature
      - e. Moisture
  - E. Fruit and seed development
    - 1. Physiological factors affecting development
    - 2. Horticultural factors affecting development
  - F. Dormancy and resting stage
    - 1. Forces inducing condition
    - 2. Forces of cancellation
  - G. Senescence
    - 1. Induction
    - 2. Retardation

- II. Forces Affecting Plant Development
  - A. Moisture
    - 1. Soil (optimum quantities)
      - a. Factors affecting optimum
      - b. Factors affecting, adverse
    - 2. Atmospheric humidity
      - a. High
      - b. Low
  - B. Oxygen
    - 1. Soil (factors affecting optimum)
    - 2. Atmosphere (negative factors)
  - C. Temperature
    - 1. Effect on roots: optimum (maximum and minimum)
    - 2. Effect on shoots: optimum (frost and freeze)
  - D. Light
    - 1. Effect on roots (negative)
    - 2. Effect on shoots (apical meristems)
  - E. Elements of nutrition
    - 1. Major elements
    - 2. Minor elements
    - 3. Trace elements
    - 4. Effects on C/N ratio in relation to vegetative and bud differentiation, cellular strength, and substance
  - F. Competitive forces affecting plant development
    - 1. Weeds
    - 2. Insects
    - 3. Disease

    4. Nematodes
    5. Self and neighbor
- III. Application of Theory
  - A. Sexual and asexual propagation
    1. Germination
    2. Root initiation
    3. Forces affecting *a* and *b* and their applications
       - a. Moisture
       - b. Oxygen
       - c. Temperature
       - d. Light
  - B. Scheduling plant development
    1. Time cycle
       - a. Annuals
       - b. Perennials
    2. Seeding (asexual technique)
       - a. Transplanting
       - b. Fertilization
       - c. Pruning—plant training to induce bud formation for bloom and fruit

Recommended Laboratory Projects—96 hours

- I. Propagate by sexual and asexual means.
  - A. Seed treatments and sowing (12 hours)
    1. Media
    2. Disease control
    3. Dormancy control
    4. Chemical treatments
    5. Temperature controls
    6. Transplanting and growing-up
  - B. Asexual—cuttings and grafts (36 hours)
    1. Techniques; procedures
    2. Growth regulators
    3. Chemicals
    4. Media
    5. Environmental controls
- II. Manage the tops of horticultural crops.
  - A. Pruning and shearing (24 hours)
    1. Trees
    2. Shrubs
    3. Vines
  - B. Lawns and grasses (24 hours)
    1. Seed mixture and formula making
    2. Renovation
    3. Construction

Texts and References

BONNER *and* GALSTON. *Principles of Plant Physiology.*
CALIFORNIA AGRICULTURAL EXTENSION SERVICE Manual 23. *The U.C. System-Container Grown Plants.*
CHRISTOPHER. *The Pruning Manual.*
CROCKER *and* BARTON. *Physiology of Seeds.*
EAMES *and* MACDANIELS. *An Introduction to Plant Anatomy.*
HARTMANN *and* KESTER. *Plant Propagation.*
JANICK. *Horticultural Science.*
LEVITT. *The Hardiness in Plants.*
SINNOT. *Plant Morphogensis.*
U.S. DEPT. OF AGRICULTURE MISCELLANEOUS PUBLICATION 654. *Woody Plant Seed Manual.*

Instructional Aids

Diagrams and charts of germination, grafting, and other processes
2" x 2" slides

HORTICULTURAL SOILS

Hours Required

Class, 2; Laboratory, 2

Course Description

This course does not follow the usual order of subject matter in textbooks on soils. It emphasizes soil management for intensive, rather than extensive, horticultural plant production. The laboratory work teaches the student soil testing and analysis, proper soil structure, porosity, *p*H values, nutrient content, and soil management as these relate to horticulture.

Major Divisions

		Class Hours
I.	Soil Texture: Effect on Plant Root Systems	4
II.	Mineral Soil and Modification	4
III.	Organic Soil: Effect on Plant Root Systems	4
IV.	Artificial Soil Mixes	4
V.	Soil *p*H: Effect on Plant Life	4
VI.	Plant Nutrients: Effect on Plant Development	4
VII.	Fertilizers	4
VIII.	Soil Management Programs	4
	Total	32

Units of Instruction

- I. Soil Texture: Effect on Plant Root Systems
  - A. Soil separation
    - 1. Sand, silt, clay
    - 2. Loams
    - 3. Effect on root penetration
    - 4. Effect on soil water
      - a. Infiltration
      - b. Permeability
      - c. Water holding capacities
  - B. Value of porosity for air content
  - C. Plant root relationship
    - 1. Root structure
    - 2. Water and oxygen requirements
  - D. Soil texture testing and identification
  - E. Demonstration of various mineral soils
    - 1. For porosity
    - 2. For water movement
    - 3. For water holding capacities
- II. Mineral Soil and Modification
  - A. Soil structure
    - 1. Mineral and organic colloids
    - 2. Effect of organic colloids on soil structure
    - 3. Mineral colloid lattice
    - 4. Organic colloid amorphus complex
    - 5. Effect of organic colloids on clay colloids
    - 6. Use of fibrous *vs.* humus materials to alter soil porosity
    - 7. Green manures—sod crops
    - 8. Manures, peats, wood chips, and sawdust
  - B. Soil tests
    - 1. Colloidal organic matter tests
    - 2. Total organic water test
    - 3. Effect of organic matter on porosity (demonstration suggested)
- III. Organic Soils: Effect on Plant Root Systems
  - A. Origin
    - 1. Woods peat (leaf mold)
    - 2. Moss peats
    - 3. Sedimentary peat
    - 4. Moisture and oxygen relationships
    - 5. Effect of moisture and oxygen on root development
    - 6. Adapting plants indigenous to organic soils to mineral soils
  - B. Study of root systems for comparison (suggested examples)
    - 1. Azalea compared to viburnum
    - 2. Barberry compared to oak
    - 3. Apple compared to privet
    - 4. Pitch pine compared to white pine
  - C. Nursery grown plants (demonstrate)
    - 1. Bare root and root protection devices
    - 2. Ball and burlap (B&B), various sizes and techniques
- IV. Artificial Soil Mixes
  - A. Purpose of mixes
  - B. Values; shortcomings
  - C. Formulations
  - D. Effect on root structure
  - E. Use in plant growing containers
  - F. Adapting container grown plants to mineral soil
  - G. Plants grown in artificial soil mixes compared with plants grown in mineral soil

V. Soil *p*H: Effect on Plant Life
  A. Principle of ionic exchange
  B. Active and potential *p*H
  C. The *p*H scale
  D. Plant tolerance to soil acidity
  E. Altering soil *p*H values
  F. Kinds of lime
  G. Lime calculations
  H. Acidifying soils
  I. *p*H testing of soils (demonstrate)
    1. Colorimetric
    2. *p*H meter

VI. Plant Nutrients: Effect on Plant Development
  A. Role of major elements in plant nutrition
  B. Role of the lesser elements
  C. Manner of entry into plant
  D. Identification and measurement of nutrients in soils
  E. Soluble salt determination
  F. Spurway system soil tests on plant nutrients

VII. Fertilizers
  A. Recognition of important inorganic fertilizers
  B. Recognition of important organic fertilizers
  C. Recognition of values of A and B
  D. Recognition of use and costs
  E. Calculations of complete fertilizers
  F. Identification of various inorganic fertilizers
  G. Identification of various organic fertilizers
  H. Calculation of amount of fertilizer to apply, based on soil tests

VIII. Soil Management Programs
  A. Establishing optimums for specific crops in relation to
    1. Soil type
    2. Soil tilth
    3. Water requirements
    4. *p*H and adjustments
    5. Nutrient requirement
    6. Fertilizers, and time and rate of application
  B. Evaluating less than optimum systems

Recommended Laboratory Projects—32 hours

I. Determine texture of different soils and observe effect on plant root systems (2 hours).
II. Examine mineral soils and modify as directed (2 hours).
III. Examine organic soils and observe root action (2 hours).
IV. Analyze soil to determine organic matter (2 hours).
V. Examine artificial soil mixes and make mixes for different purposes (4 hours).
VI. Test soils for *p*H and note effect of *p*H on plant life (4 hours).
VII. Study the different plant nutrients and their effects on plant development (4 hours).
VIII. Study fertilizers; make several formulations for different uses (6 hours).
IX. Propose soil management programs for horticultural crops of the area (6 hours).

Texts and References

BEAR. *Soils and Fertilizers.*
COLLINGS. *Commercial Fertilizers.*
DONAHUE. *Our Soils and Their Management.*
———. *Soils and Plant Growth.*
YEARBOOK OF AGRICULTURE 1938. *Soils and Men.*
YEARBOOK OF AGRICULTURE 1941. *Climate and Man.*
YEARBOOK OF AGRICULTURE 1952. *Soils.*
YEARBOOK OF AGRICULTURE 1957. *Water.*

Instructional Aids

Assortment of soil samples
Soil profiles
Soil maps of the area
Potted plants, with different soil acidity and levels of nutrients

PLANT PATHOLOGY

Hours Required

Class, 3; Laboratory, 3

Course Description

This course (a continuation of Entomology and Plant Disease Control) provides an indepth study of the pests, insects, and diseases which damage shrubs, flowers, ornamental trees, and turfgrass. Laboratory projects and class study emphasize control and treatment methods and the proper and safe use of chemicals, pesticides, herbicides, and various hand- and power-operated application equipment.

Most of the laboratory time involves field study in which students identify plant insects, diseases, and weed types and gain experience in handling and applying control agents. Recommended laboratory projects also include learning how to drive tractors and to use application equipment. Applicators—sprayers, granular spreaders, dusters, and mist blowers—vary in size from the small manual types to the power-operated, tractor-drawn types.

Major Divisions

	Class Hours
I. Course Introduction and Basic Principles	3
II. Methods of Pest Control	3
III. Chemicals for Control of Insects and Diseases	3
IV. Application Equipment	4
V. Dormant Spray Work	3
VI. Pesticide Formulations	3
VII. Pesticide Safety	2
VIII. Pests of Lawns and Fine Turf	3
IX. Pests of Roses and Garden Flowers	3
X. Pests of Narrowleaved Evergreens	3
XI. Pest of Broadleaved Evergreens	3
XII. Pests of Trees and Shrubs	3
XIII. Pests of Fruit Trees	3
XIV. Weeds and Weed-Control Problems	3
XV. Types of Weeds and Special Weed Problems	3
XVI. Herbicides—Use and Application	3
Total	48

Units of Instruction

- I. Course Introduction and Basic Principles
  - A. Introduction
    - 1. Definition of pest control
    - 2. Basic problems
    - 3. General approach
  - B. Reasons for using controls
    - 1. Healthy crop
    - 2. Earn good livelihood
    - 3. Reduce loss and waste
    - 4. Good practice
- II. Methods of Pest Control
  - A. Cultural
    - 1. Good sanitation practices
    - 2. Good fertilizer program
    - 3. Use of resistant-type plants
    - 4. Good pruning and cultivating practices
    - 5. Follow spray program
  - B. Biological control
    - 1. Definition
      - a. Parasites
        - (1) Natural
        - (2) Introduced
      - b. Predators
        - (1) Natural
        - (2) Introduced
    - 2. Encouragement of natural beneficial forms
      - a. Insects
        - (1) Lady beetles
        - (2) Other
      - b. Birds
      - c. Diseases
      - d. Domestic fowl
    - 3. Introduction of beneficial insects, birds, etc.
  - C. Control of pests by legal means
    - 1. Obey the law
      - a. Have plants inspected
      - b. Clearance before shipping
      - c. Avoid contamination of healthy land with soil, tools, and plant equipment that are infected
    - 2. Apply pesticides at proper times
  - D. Mechanical controls

1. Insect traps, such as those for Japanese beetles
2. Screening
3. Draining areas
4. Flooding areas
5. Extreme heat

E. Chemical controls
  1. Stomach poisons
    a. Sprays
    b. Dusts
    c. Granules
    d. Aerosols
  2. Contact materials
    a. Sprays
    b. Dusts
    c. Granules
    d. Aerosols
    e. Fumigation
  3. Repellents

III. Chemicals for Control of Insects and Diseases
  A. Old standard materials
    1. Arsenicals
    2. Cryolite
    3. Oils
    4. Others
  B. Newer organics
    1. Chlorinated hydrocarbons
      a. DDT (or its successor), marlate, DDD
      b. Chlordane
      c. Aldrin, Dieldrin
      d. Lindane (benzene hexachloride)
      e. Others
    2. Organic phosphates
      a. Parathion
      b. Malathion
      c. Diazinon
      d. Guthion
      e. Thimet
      f. Others
    3. Carbamates such as Carbaryl (Sevin)
    4. Acaricides
      a. Aramite
      b. Kelthane
      c. Chlorobenzilate
      d. Tetradifon (Tedion)
      e. Others
    5. Plant derivatives
      a. Rotenone
      b. Nicotine
      c. Sabadilla
      d. Ryania
      e. Others
  C. Systemics

IV. Application Equipment
  A. Sprayers
    1. Hand-operated
      a. "Flit" gun type
      b. 3- to 5-gallon tank type
      c. Knapsack sprayer
      d. Wheelbarrow sprayer
    2. Power-operated
      a. Small 5-gallon power sprayer
      b. Small 15- to 25-gallon power sprayer (Spartan type)
      c. Wheelbarrow sprayer
      d. Electric greenhouse sprayer
      e. Estate sprayer, 30- to 50-gallon
      f. 100- to 500-gallon large sprayers (hydraulic)
        (1) Separate body on wheels, tractor drawn
        (2) Mounted on flat-bed truck body
        (3) Mounted on skid, tractor drawn
        (4) Row crop sprayer
        (5) "High Boy" crop sprayer (corn)
    3. Mist blowers
      a. Small knapsack
      b. Large power
    4. Fog machine and smoke generators
    5. Aircraft
      a. Helicopter
      b. Airplane
  B. Dusters
    1. Hand dusters
      a. "Puff" dusters
      b. Cylinder dusters
      c. Rotary crank
      d. Bellows knapsack
    2. Power dusters
      a. Large row crop dusters
      b. Large wet dusters
      c. Tandem dusters
    3. Aircraft
      a. Helicopter
      b. Airplane
  C. Granular applicators
    1. Hand "cyclone seeder"
    2. Small 2-wheel cyclone spreader
    3. Small 20″-36″ lawn fertilizer spreader
    4. Large "Gandy type" fertilizer granule spreader

- D. Other types
    - 1. Aerosol bombs
        - a. Small, hand
        - b. Large greenhouse (4 lb. bomb)
    - 2. Smoke generators and pressure fumigators
    - 3. Impregnated candles
    - 4. Soil injector for tear gas, etc.
        - a. Small 1-square-foot applicator
        - b. Large tractor-drawn injector
    - 5. Poison baits
- E. Spray guns
    - 1. Low pressure gun for small tank type sprayer
    - 2. All purpose gun
    - 3. Shade tree gun
    - 4. Orchard gun
    - 5. Boom type for lawn areas

V. Dormant Spray Work
- A. Importance
- B. Pests controlled
    - 1. Scales
    - 2. Insect eggs
    - 3. Disease spores
- C. When applied and why
- D. Chemicals used
    - 1. Dinitro ortho cresol
    - 2. Miscible oil
        - a. Paraffin base
        - b. 60-70 sec. viscosity
    - 3. Lime-sulfur
    - 4. Warnings—restrictions on use of each

VI. Pesticide Formulations
- A. Solutions
- B. Miscible oils
- C. Wettable powders
- D. Emulsifiable concentrates
- E. Dusts
- F. Granules
- G. Volatile solids
- H. Liquefied gases
- I. Aerosols

VII. Pesticide Safety
- A. The Miller Pesticide Amendment
    - 1. Significance
    - 2. Details of the amendment
    - 3. Changes
- B. The pesticide label
    - 1. Read and comprehend
    - 2. Follow instructions
- C. Safety use
    - 1. Respirators
    - 2. Gas masks and canisters
    - 3. Protective gear
    - 4. First-aid treatment
    - 5. List of antidotes and doctors
- D. Suggestions for careful application

VIII. Pests of Lawns and Fine Turf
- A. Insects and mites
    - 1. Chewing
    - 2. Piercing-sucking
    - 3. Mounds and earth disruption
- B. Diseases
    - 1. Leaf spots
    - 2. Large blighted areas
    - 3. Snow mold
    - 4. Other
        - a. Mushrooms (fairy ring)
        - b. Slime mold
- C. Other pests
    - 1. Moles
    - 2. Earthworms
    - 3. Birds
- D. Physiopathologic conditions
    - 1. Fertilizer burn
    - 2. Compaction
    - 3. Others
- E. Illustrated with Kodachrome slides

IX. Pests of Roses and Garden Flowers
- A. Insects and mites
    - 1. Chewing
    - 2. Piercing-sucking
- B. Diseases (illustrate with slides)
    - 1. Leaf diseases
    - 2. Cankers
    - 3. Nematodes
    - 4. Soil diseases

X. Pests or Narrowleaved Evergreens (illustrate with slides)
- A. Pines
    - 1. Insects
    - 2. Diseases
    - 3. Physiopaths
- B. Spruce and firs
    - 1. Insects
    - 2. Diseases
    - 3. Physiopaths
- C. Hemlocks
    - 1. Insects
    - 2. Diseases
    - 3. Physiopaths
- D. Yews
    - 1. Insects
    - 2. Diseases

    - 3. Physiopaths
  - E. Other
- XI. Pests of Broadleaved Evergreens (illustrate with slides)
  - A. Rhododendron
    - 1. Insects
    - 2. Diseases
    - 3. Other
  - B. Mountain laurel
  - C. Ilex-hollies
  - D. Boxwood
  - E. Other
- XII. Pests of Trees and Shrubs (illustrate with slides)
  - A. Maples
    - 1. Insects and mites
      - a. Chewing insects
      - b. Piercing-sucking pests
      - c. Borers
      - d. Galls
    - 2. Diseases
      - a. Foliage diseases
      - b. Vascular diseases
      - c. Physiopaths
  - B. Elms
  - C. Oaks
  - D. Birch
  - E. Other trees and shrubs
- XIII. Pests of Fruit Trees (illustrate with slides)
  - A. Apples
    - 1. Insects and mites
      - a. Chewing
      - b. Piercing-sucking
      - c. Borers
    - 2. Diseases
      - a. Foliage
      - b. Fruit
      - c. Other
    - 3. Growth problems
  - B. Peaches
  - C. Cherries
  - D. Other tree fruits
- XIV. Weeds and Weed-Control Problems
  - A. Economics problems (losses)
    - 1. Crop losses
    - 2. Disease and insect hosts
    - 3. Rob nutrients
  - B. Public health problems
    - 1. Hay fever plants
    - 2. Poison ivy and sumac
  - C. General all-purpose weed control
    - 1. Driveways, roadways
    - 2. Around gas and fuel storage areas
    - 3. On airstrips and parking lots
    - 4. Cleanup areas
  - D. Selective weed control
    - 1. Weeds with broadleaves in monocot plants, such as grasses
    - 2. Grasses in dicot plants with broadleaves
    - 3. Weedy grass in lawn areas
    - 4. Special problems
  - E. Timing
    - 1. Pre-emergence
    - 2. Post-emergence
- XV. Types of Weeds and Special Weed Problems
  - A. Types
    - 1. Annual weeds
    - 2. Biennial weeds
    - 3. Winter annuals
    - 4. Perennial weeds
    - 5. Woody plants
  - B. Special problems
    - 1. Aquatic weeds
    - 2. Poison ivy control
    - 3. Ragweed control
    - 4. Prickly pear cacti
    - 5. Dodder control
    - 6. Crabgrass
- XVI. Herbicides—Use and Application
  - A. Definition
  - B. All-purpose herbicides
  - C. Selective herbicides
  - D. Method of kill
    - 1. Contact
    - 2. Translocated
  - E. Effect on weeds; hormone stimulus with 2,4-D action
  - F. Kinds of pesticides
    - 1. 2,4-D group
      - a. Translocated
      - b. Selective for broadleaves
      - c. Hormone kill
    - 2. Arsenicals
      - a. Lead arsenate complex
      - b. Tricalcium arsenate
    - 3. Carbamates
    - 4. Substituted ureas
      - a. Monuron
      - b. Diuron
      - c. Others

        5. Amino-triazole
        6. Simazine
        7. Others
    G. Application
        1. Timing
            a. Pre-emergence
            b. Postemergence
        2. Granular spreaders
            a. Most important
            b. Most commonly used
        3. Foliage spray
        4. Mixed with soil

Recommended Laboratory Projects—48 hours

I. Study dormant stages of insects (3 hours).
    A. Collect overwintering stages of insects on plants followed by laboratory study of each
    B. Examine dormant spray materials and study their application
II. Practice field handling of equipment (6 hours).
    A. Drive tractors
    B. Practice driving, turning, and backing with trailers
    C. Use service sprayers
        1. Purpose of pressure regulator
        2. Purpose of air chamber
        3. The ball and seat valves
        4. Other parts
    D. Oil, grease, and repair equipment for use
III. Apply pesticides with large hydraulic sprayers and mist blowers in spraying large trees and evergreens (9 hours).
    A. Oil
    B. Dinitro
    C. Lime-Sulfur
IV. Treat lawns to control dandelions and other broad leaves (6 hours).
    A. Fifty-five-gallon drum w/hydraulic lift to be mounted on Ford-type tractor
    B. Principles of calibration of sprayer
    C. Application to lawn areas
V.
VI. } Make a field study of insects, diseases,
VII. and early weeds (9 hours).
    A. Identification and collection
    B. Life histories
    C. Special data
    D. Control of each
VIII. Apply foliage spray and dust to plants and crops (3 hours).
IX.
X. } Study additional insects, diseases, and
XI. weeds (as time allows).
XII. Consider special problems of the region (6 hours).
    A. Grub-proofing of lawn areas
    B. Poison ivy control
    C. Granular application both pre- and postemergence for crabgrass
    D. Borer control on trees

Texts and References

AHLGREN *and* others. *Principles of Weed Control.*
DODGE, RICKETT *and* PIRONE. *Diseases and Pests of Ornamental Plants.*
KLINGMAN. *Weed Control as a Science.*
MUENSCHER. *Weeds.*
PFADT. *Fundamentals of Applied Entomology.*
POTTS. *Concentrated Spray Equipment; Mixtures and Application Methods.*
PYENSON. *Keep Your Garden Healthy.*
ROBBINS *and* others. *Weed Control.*
SCOTT. *Insecticidal Equipment for the Control of Insects.*
U.S. DEPARTMENT OF AGRICULTURE. Miscellaneous Handbook 626. *Handbook on Insects and Enemies of Flowers and Shrubs.*

Instructional Aids

2″ x 2″ Kodachrome slides
Preserved and herbarium specimens
Wall charts and diagrams
16 mm films
Large and small spray equipment, spray guns, etc.

Auxiliary and Supporting Technical Courses

ARBORIST BUSINESS

Hours Required

Class, 1; Laboratory, 3

Course Description

This course presents the underlying principles of the arborist business as a specialized service enterprise. It analyzes the business factors affecting competition for private and residential work and contract work for utilities, municipalities, and industrial campuses. Since the primary aim of an arborist business is to earn a profit, this course emphasizes the reasons for success and failure. Students are exposed to local business situations as much as possible and maximum use of resource people from the local arborist industry is recommended. Field trips to observe office procedures of successful companies, and visits to vendors, and work sites are suggested as a part of the laboratory work.

Major Divisions

	Class Hours
I. Arborist Business	12
II. Laws and Ordinances	2
III. Shade Tree Production	2
Total	16

Units of Instruction

I. Arborist Business
   A. Attributes of success
      1. Knowledge of the subject
      2. Business experience
      3. Work experience
      4. Organizational ability
      5. Sufficient capital
      6. Drive
      7. Personality
   B. Business knowledge
      1. Letter writing
      2. Language ability
      3. Salesmanship
      4. Financing
      5. Purchasing
      6. Cost analysis
      7. Estimating
      8. Pricing
      9. Other
   C. Capitalization
      1. Tangible assets
         a. Real estate
         b. Office furnishings
         c. Equipment
         d. Tools
         e. Supplies and materials
         f. Operating reserves
      2. Intangible assets
         a. Goodwill
         b. Know-how
         c. Capable personnel
         d. Esprit de corps
   D. Operating costs
      1. Direct
         a. Labor and management
         b. Equipment use
         c. Equipment rental
         d. Equipment maintenance
      2. Indirect
         a. Taxes
         b. Insurance needs
         c. Office overhead
         d. Depreciation
         e. Other
   E. Location of business (factors)
      1. Ease of transportation
      2. Income bracket of clientele
      3. Tree-conscious communities
      4. Zoning ordinances
         a. Office
         b. Warehouse
         c. Garage
   F. Development of work
      1. Direct solicitation
      2. Recommendation by others
      3. Successful bidding for contract work
      4. Advertising
      5. Publicity
   G. Contracting for work
      1. Sound estimating
      2. Accepted standards of workmanship
      3. Written agreement

- H. Expediting
  - 1. Planning: who, when, what, where, and how
    - a. Establish dates for accomplishment
    - b. Routing of jobs
    - 3. Conference with job foreman
    - d. Description of work
    - e. Disposal of material
  - 2. Performance of work
    - a. Punctuality
    - b. Deportment
    - c. Job cleanup
    - d. Daily work reports
    - e. Customer approval and consideration of other work needs
  - 3. Billing
    - a. Promptly
    - b. Regularly
- I. Office procedures
  - 1. Communications
    - a. Correspondence
    - b. Telephone
      - (1) Answering service
      - (2) Monitoring devices
      - (3) Credit cards
    - c. Short wave radio
  - 2. Business forms
    - a. Transactions
    - b. Inventory and recordkeeping
    - c. Employment
    - d. Servicing and repair records
    - e. Location plans
  - 3. Handbook of company policies for employees

- II. Laws and Ordinances
  - A. Small and large village
  - B. City and township
  - C. County
  - D. Other authorities

- III. Shade Tree Production
  - A. Costs and returns
  - B. Factors of efficient production
    - 1. Small business
    - 2. Large business
  - C. Profitable and unprofitable trees

Recommended Laboratory Projects—48 hours

- I. Visit local arborist businesses and prepare reports on them as directed (12 hours).
- II. Report on the presentation of a local arborist telling about his business (3 hours).
- III. Visit the work sites of local arborist jobs and write reports on them (6 hours).
- IV. Make estimates for selected tree pruning and repair jobs (6 hours).
- V. Study and compare ordinances affecting arborists (6 hours).
- VI. Visit tree nurseries to study costs and returns (6 hours).
- VII. Compute costs (in detail) to take down and remove a large tree (3 hours).
- VIII. Set up a hypothetical arborist business among members of the class (6 hours).

Texts and References

CHRISTOPHER. *Pruning Manual.*
FENSKA. *Tree Experts Manual.*
PIRONE. *Tree Maintenance.*
THOMPSON. *Trees for American Gardens.*
Proceedings of the International Shade Tree Conference.

Instructional Aids

Brochures and catalogs from companies
Ordinances, contracts, and specifications
Slides, pictures, and charts
Reports of local and regional symposiums

LANDSCAPE CONTRACTS AND SPECIFICATIONS

Hours Required

Class, 2; Laboratory, 0

Course Description

This course is designed with the profit motive in mind for the ornamental horticulture student. This principle has been introduced through other courses. Attention is given to the technicalities of contract and specification writing, with considerable time devoted to calculation methods and the analysis of estimating and cost-finding procedures. Sound business principles, fundamental aspects of selling, and the importance of sound professional approaches are stressed.

Major Divisions

	Class Hours
I. Introduction	1
II. The Law of Contracts	2
III. Torts, Agency, the Independent Contractor	2
IV. Real Property and Liens	1
V. Partnerships, Corporation, and Individual Proprietorships	2
VI. Types of Construction Contracts	2
VII. Construction Insurance and Surety Bonds	2
VIII. Contracts for Professional Services	2
IX. Specification Writing	5
X. Assembling the Specifications	1
XI. Calculations Methods, Estimating Procedures, and Cost-Finding Procedures	4
XII. Location of Business Site	2
XIII. Business Success	2
XIV. Design and Display for Profit	2
XV. Promotional Advantages	2
Total	32

Units of Instruction

I. Introduction
  A. Public and private construction
  B. Types of contracting
    1. General contracting
    2. Subcontracting
  C. Professional code of ethics

II. The Law of Contracts
  A. Essential elements of contracts
  B. Statute of frauds
  C. Changes in contracts
  D. Termination

III. Torts, Agency, the Independent Contractor
  A. Torts
    1. Slander
    2. Libel
    3. Trespass
    4. Nuisance, etc.
  B. Riparian rights
  C. Discharge of a tort
  D. Agency authority and duties
  E. The principal's responsibilities
  F. Contingent liability

IV. Real Property and Liens
  A. Easements, right-of-way
  B. Mechanics' liens
  C. Eminent domain

V. Partnerships, Corporation and Individual Proprietorships
  A. Differences
  B. Liabilities
  C. Public and private corporations
  D. Fiduciary relationships
  E. Ultra vires acts

VI. Types of Construction Contracts
  A. Competitive bid
  B. Lump sum
  C. Unit price
  D. Combinations
  E. Negotiated

VII. Construction Insurance and Surety Bonds
  A. Insurance
    1. Fire
    2. Liability
    3. Burglar
    4. Compensation
  B. Surety bonds
    1. Bid bond
    2. Performance bond
    3. Payment bond
    4. Miscellaneous bonds
    5. Warranty

- VIII. Contracts for Professional Services
  - A. Services performed
  - B. Determination of fee
    - 1. Per diem
    - 2. Percentage
    - 3. Flat rate or lump sum
    - 4. Hourly rate
    - 5. Extra work
    - 6. Supervision
- IX. Specification Writing
  - A. Principles
    - 1. Style
    - 2. Grammar
    - 3. Brevity
    - 4. Clarity
  - B. General provisions
    - 1. Description of work
    - 2. Drawings
    - 3. Work and material by others
    - 4. Conflicts and omissions
    - 5. Tests
    - 6. Wages
  - C. Technical provisions
    - 1. Types
    - 2. Specifications for materials
    - 3. Specifications for work to be performed
    - 4. Use of standard specifications
- X. Assembling the Specifications
  - A. Title
  - B. Outline
  - C. Construction
  - D. Table of contents
- XI. Calculation Methods, Estimating Procedures, and Cost-Finding Procedures
  - A. Area, volume, and quantity calculation review
  - B. Material costs
    - 1. Construction
    - 2. Plant materials
  - C. Overhead
  - D. Profit calculated on selling price
  - E. Markup calculated on cost
  - F. Estimating procedures
    - 1. Experience best guide
    - 2. Need for complete analyses
- XII. Location of Business Site
  - A. Considerations
    - 1. Planning
    - 2. Location
    - 3. Buildings
    - 4. Lighting
    - 5. Parking
    - 6. Service area
    - 7. Rest rooms
    - 8. Activity area (for children)
  - B. Purchase or lease
- XIII. Business Success
  - A. Salesman education
    - 1. New salesmen
    - 2. Experienced salesmen
  - B. Instruction—successful supervision
    - 1. Tell
    - 2. Show
    - 3. Do
  - C. Study methods
  - D. Success takes time
    - 1. Pride
    - 2. Set goal
    - 3. Be creative
  - E. Profit from prestige and knowledge
- XIV. Design and Display for Profit
  - A. Design
    - 1. Goodwill, an intangible
    - 2. Help customer buy
    - 3. Simplicity
      - a. No "gingerbread"
      - b. Don't confuse with sign surplus
    - 4. Helps to better advertising
    - 5. Company identification
  - B. Display
    - 1. Impulse sales
    - 2. Patio purchases
    - 3. Help customer "visualize"
    - 4. Make display informative
    - 5. Price signs
    - 6. Always display your name on signs
    - 7. Locate general display for all to see, etc.
- XV. Promotional Advantages
  - A. More profits from sincerity
    - 1. Sell prestige
    - 2. Be part of community
    - 3. High-pressure salesmanship often harmful
  - B. Promote advantages
    - 1. Analysis of people buy services
    - 2. Successful contracts beget new ones
    - 3. Relative standing in the available market
    - 4. Profits are necessary
    - 5. American Association of Nurserymen sales-training aids
    - 6. Business character building

Texts and References

ABBETT. *Engineering Contracts and Specifications.*

AMERICAN ASSOCIATION OF NURSERYMEN. *Merchandising and Sales Bulletins.*

DUNHAM *and* YOUNG. *Contracts, Specifications and Law for Engineers.*

MEAD *and* others. *Contracts, Specifications and Engineering Relations.*

SURTEES. *Nursery Cost Finding.*

WHITING. *The Five Great Problems of Salesmen and How to Solve Them.*

———. *The Five Great Rules of Selling.*

LANDSCAPE SURVEYING

Hours Required

Class, 2; Laboratory, 3

Course Description

An introductory course to the importance of surveying as adapted to landscape planting and construction projects. The theory of plane surveying is taught in class sessions and the various surveying instruments are used during field exercises, with emphasis placed on the fundamental methods used by landscape designers and contractors. Instruction is presented in topographical mapping, the measurement of land areas, establishing grades, and the methods used in the preparation of working drawings and grading plans.

Field techniques are presented and developed through laboratory problems in pacing, taping, differential leveling, profile leveling, measurement of angles and directions, plane table usage, topographic map development, better board construction, and notekeeping.

The students are introduced to surveying procedures and acquire an appreciation of the problems confronting surveying engineers, and learn to execute many surveying procedures that do not require registered engineers or surveyors.

Major Divisions

	Class Hours
I. Definitions and Notekeeping	1
II. Measurement of Distance	2
III. Direct Leveling	4
IV. Differential and Profile Leveling	4
V. Measurement of Angles and Directions	4
VI. Calculation of Land Areas	4
VII. Topographical Mapping	5
VIII. Plane Table	4
IX. Topographical Surveying	4
Total	32

Units of Instruction

I. Definitions and Notekeeping
  A. Kinds of surveying
  B. Field work
    1. Typical surveys
    2. Care and handling of instruments
    3. Precision instruments
    4. Field notes
  C. Office work
    1. General
    2. Computations
    3. Significant figures
    4. Graphical and mechanical methods
    5. Drafting
  D. Errors
    1. Sources of error
    2. Kinds of error
    3. Theory of probability

II. Measurement of Distance
  A. Methods
  B. Equipment for measuring
  C. Handling the steel tape
    1. Measuring on level ground
    2. Slope measurements
    3. Errors in taping
  D. Corrections
    1. Mistakes in taping
    2. Erecting perpendicular to line

III. Direct Leveling
  A. General
  B. Instruments
    1. Engineer's level
    2. Dumpy level
    3. Wye level
    4. Locke and Abney hand levels
    5. Engineer's transit
    6. Leveling rods
  C. Setting up instruments
    1. Reading the rods
    2. Reading verniers
  D. Adjustment of instruments

IV. Differential and Profile Leveling
  A. Differential leveling
    1. Procedure
    2. Balancing backsight and foresight distances
    3. Notes
    4. Mistakes and errors
    5. Precision
  B. Profile leveling
    1. Notes
    2. Vertical curves
    3. Plotting profiles
    4. Fixing grades
    5. Leveling for earthwork

- V. Measurement of Angles and Directions
  - A. General considerations
  - B. Magnetic meridian
    - 1. Magnetic declination
    - 2. Establishing the meridian
  - C. Angles and directions
    - 1. Bearings
    - 2. Azimuths
    - 3. Deflection angles
    - 4. Interior angles
  - D. Traverses
  - E. Triangulation

- VI. Calculation of Land Areas
  - A. Methods of determining area
    - 1. Area by coordinates
    - 2. Area of tract with irregular boundaries
  - B. Offsets
    - 1. Regular intervals
    - 2. Irregular intervals

- VII. Topographical Mapping
  - A. Relief maps
    - 1. Contour lines
    - 2. Contour interval
    - 3. Contour map construction
    - 4. Interpolation
    - 5. Systems of ground points
    - 6. Tests for accuracy
    - 7. Choice of scale
  - B. Topographic maps
    - 1. Cross sections and profiles
    - 2. Roadway earthwork
    - 3. Earthwork for grading areas
    - 4. Route location

- VIII. Plane Table
  - A. General considerations
  - B. Equipment
    - 1. Tables
    - 2. Alidades
    - 3. Compasses and levels
    - 4. Plane table sheet
  - C. Setup and orientation of table
  - D. Methods of plotting
    - 1. Radiation
    - 2. Traversing
    - 3. Intersection
  - E. Differences in elevation
  - F. Field checks

- IX. Topographical Surveying
  - A. General considerations
  - B. Control
    - 1. Horizontal
    - 2. Vertical
  - C. Location of details
    - 1. Controlling point method
    - 2. Cross profile method
    - 3. Checkerboard method
    - 4. Trace contour method
  - D. Site and construction surveys
    - 1. Building site surveys
    - 2. Land surveys

Recommended Laboratory Projects—48 hours

- I. Determine length of pace; measure distances by pacing (3 hours).
- II. Develop a problem involving measurements with various types of tapes (3 hours).
- III. Introduce students to various types of levels and develop a problem involving use of levels (6 hours).
- IV. Determine elevations necessary for plotting the profile of a line (6 hours).
- V. Develop a problem involving measurement of horizontal angles by a transit with both the verniers and compass (6 hours).
- VI. Using the preceding problem, have the students balance the survey by the compass and calculate the area (6 hours).
- VII. Construct a complete topographical map from the data derived from projects V and VI. The relief should be represented with contour lines (6 hours).
- VIII. Make a plane table survey of an assigned area of the campus by a combination of the methods of intersection, radiation, and traversing (6 hours).
- IX. Map an area of the campus in a large scale of small contour interval. The area should contain few details and have a relatively smooth terrain. Each crew should work toward producing a composite map (6 hours).

Texts and References

BREED *and* HOSMER. *Surveying, vol. I.*
DAVIS *and* FOOTE. *Surveying.*
DAVIS *and* KELLY. *Short Course in Surveying.*

THEROUX *and* others. *Plane Surveying.*
THEROUX *and* SMITH. *Surveying Field Problems and Notebooks.*

Instructional Aids—Field and Laboratory Equipment

Line levels
Locke hand levels
Abney hand levels
200-ft. engineer's tape
100-ft. engineer's tape
50-ft. engineer's tape
Architect's tape of various lengths
Metallic tape of various lengths
Dumpy levels
Wye levels
Transits
Philadelphia rods
Planimeters
Range poles
Plumb bobs

SALESMANSHIP

Hours Required

Class, 3; Laboratory, 0

Course Description

This course places emphasis upon the five basic principles of selling and is designed to meet the needs of prospective employees in the varied fields of ornamental horticulture. This is a HOW TO DO course. Although the necessary qualities for good selling are listed, and the necessary principles of good selling are accounted for, the stress is upon the manner in which these qualities and these principles can be developed and applied.

Actual sales talks are prepared by the students. Sales experts are invited to lecture when they are available, and graduates successfully employed in their fields are asked, whenever possible, to discuss their experiences in selling.

Major Divisions

	Class Hours
I. Gaining Attention	8
II. Arousing Interest	9
III. Convincing the Prospect	10
IV. Arousing Desire	9
V. Closing the Sale	12
Total	48

Units of Instruction

I. Gaining Attention
  A. "Every Living Creature Loves Itself"
  B. The question opener
  C. The explosive-type opener
  D. The interest getter
  E. The "for-instance" opener
  F. The "believe-it-or-not" approach
  G. The "big-name" opener
  H. The "screw-driver" opener
  I. The exhibit attention-getter
  J. Additional attention-getters
    1. Prepare your opening remarks
    2. "Never start with an apology"
    3. Get your prospect saying "yes"
    4. Be brief
    5. Sit or stand straight; don't loll
    6. Be friendly, not over-clever
    7. Get prospect's name correctly

II. Arousing Interest
  A. "Selling, to be a Great Art, must involve a genuine interest in the other person's needs."
  B. What prospect's personal interests are
    1. Job
    2. Home
    3. Politics
    4. Recreation
    5. Events of national interest
  C. Advantages of your product or service to prospect
  D. How prospect will benefit
  E. Additional ways of arousing interest
    1. Don't leave interest step to chance
    2. Ask questions
    3. Demonstrate, when possible
    4. Avoid exaggeration
    5. Talk conversationally
    6. Be sincere
    7. Create a favorable impression within 30 seconds

III. Convincing the Prospect
  A. "Don't forget the power of *Plain Facts*"
  B. Get to the point
    1. Convince—don't asphyxiate
    2. Talk long enough—no longer
  C. Locate key issue and confine yourself to it
  D. Know a hundred times as much about what you are selling as you use in your sales talk
  E. Don't be afraid to repeat
  F. Remember—you don't always *have* to convince
  G. Be specific! Be definite! Be explicit! Avoid:
    1. Boasting
    2. Meaningless claims
    3. Knowing all the answers right off the bat
    4. Wild ideas
    5. Exaggeration
    6. Vagueness
  H. Be concrete
  I. Be clear
    1. Have subject clearly in mind
    2. Use short familiar words
    3. Don't talk too fast
    4. Avoid "trade jargon"
    5. Illustrate with diagrams and sketches
  J. Be enthusiastic about your product or service

- K. Stop talking now and then
- L. Prove some of the things you say
- M. Let your customer feel that he's deciding for himself

IV. Arousing Desire
- A. "Persuade People to Want What They Already Need"
- B. Determine buying motive of your prospect
    1. Point out his lack, want, or need
    2. Tell him your product or service will supply that need
    3. Describe the satisfaction or gratification which will result for him
- C. Appeal to the senses
- D. Appeal to the emotions
- E. Appeal to logic
- F. Let your imagination carry you into the clouds but keep your feet on the ground
- G. Be enthusiastic

V. Closing the Sale
- A. "A Good Sales Talk is a Good Thing, but the Signed Order is *the* Thing"
- B. Weigh ideas in favor of buying against those opposed to buying
- C. Remember—closing the sale is just one step in a process
- D. The psychological moment
    1. It is not a moment
    2. It may not be psychological
- E. Don't talk yourself out of a sale—watch buying signals
    1. What your prospect *does*
    2. Watch how he *looks*
    3. Note what he *says*
    4. Be alert for *buying questions*
- F. Don't be afraid to ask for the order—often
- G. Get used to hearing "no"
- H. Don't wait—close
    1. Summation of closing rules
    2. How to answer objections
        - a. Make objection reason for buying
        - b. Let prospect answer his own objection
        - c. Explain away the objection
        - d. Admit the objection, but show how other advantages outweigh it
        - e. Deny the objection

Texts and References

CANFIELD. *Salesmen and Salesmanship.*
———. *Practices and Problems.*
DENTON. *How to Sell to Women.*
FEHLMAN. *Anyone Can Sell.*
GREIF. *Modern Salesmanship.*
HAAS. *Persuasion and Motivation in Marketing.*
KAHN. *The 36 Biggest Mistakes and How to Correct Them.*
PEDERSON *and* WRIGHT. *Salesmanship; Principles and Methods.*
WHITING. *The Five Great Rules.*
WHITING *and* others. *The New Psychology.*

Instructional Aids

Lectures and/or discussions conducted by qualified outsiders employed successfully in a phase of ornamental horticulture
Films and film strips on selling
Tape recordings
Student demonstrations and sales talks
Reports by students of their experience in selling

TECHNICAL REPORTING

Hours Required

Class, 2; Laboratory, 2

Course Description

A natural extension of Communication Skills, intended to help the student achieve greater facility in his basic skills previously acquired. The student is introduced to the practical aspects of preparing reports and communicating with groups. The use of graphs, charts, sketches, diagrams, and drawings to present ideas and significant points is an important part of this course.

Emphasis should be upon techniques for collecting and presenting scientific data by means of informal and formal reports and special types of technical papers. Forms and procedures for technical reports should be studied and a pattern established for all forms to be submitted in this and other courses.

Much of the subject matter for this course may be necessary reports written for technical courses. The subject matter taught in this course should be coordinated with other courses.

Major Divisions

	Class Hours
I. Reporting	3
II. Writing Technical Reports	12
III. Illustrating Technical Reports	4
IV. The Research Paper	3
V. Oral Reporting	4
VI. Group Communication and Participation	6
Total	32

Units of Instruction

I. Reporting
  A. Nature and types of reports
  B. Objective reporting
  C. The problem concept
  D. The scientific method
    1. Meaning of the method
    2. Characteristics of the scientific method
    3. Essentials of scientific style
    4. Importance of accuracy and intellectual honesty in observation and recording
    5. Legal importance of recording data and log books
  E. The techniques of exposition
    1. Definitions
    2. Progression
    3. Elements of style
    4. Analysis of examples
    5. Methods of slanting a report
  F. Critical evaluation of a report

II. Writing Technical Reports
  A. Characteristics of technical reports
  B. Report functions
  C. Informal reports
    1. Short form reports
      a. Memorandum reports
      b. Business letter reports
      c. Progress reports
      d. Outline reports
  D. The formal report
    1. Arrangement
      a. Cover and title page
      b. Table of contents
      c. Summary of abstracts
      d. Body of the report
      e. Bibliography and appendix
      f. Graphs, drawings, or other illustrations
    2. Preparation
      a. Collecting, selecting, and arranging material
      b. Writing and revising the report
  E. Special types of papers
    1. The abstract
    2. Process explanations
    3. The case history
    4. The book review

III. Illustrating Technical Reports
  A. Illustrations as aids to brevity and clarity
  B. Use of technical sketching and drawings
  C. Use of pictoral drawings and sketches
  D. Use of diagrammatic representation
    1. Electrical diagrams and specific symbols
    2. Process flow diagrams
    3. Instrumentation diagrams
    4. Bar charts, pie diagrams, and similar presentation of data
  E. Graphical presentation of data
    1. Graphs—types of graph paper
    2. Choice of scale for graphs
    3. Points and lines; and use of data from graphs

F. Use of photographs
G. Selection of appropriate illustrations
    1. Availability
    2. Cost of preparation
    3. Maximum brevity and clarity of presentation

IV. The Research Paper
    A. Subject and purpose
    B. Source materials; bibliographical tools, periodical indexes, the library
    C. Organizing the paper
        1. A working biblography
        2. Notes and the outline
        3. The rough draft
        4. Quoting and footnoting
        5. The final paper
    D. Oral and written presentation of the paper

V. Oral Reporting
    A. Organization of material for effective presentation
    B. Formal and informal reports
    C. The use of notes
    D. The use of slides, exhibits
    E. Proper use of the voice
    F. Elimination of objectionable mannerisms
    G. Introductions

VI. Group Communications and Participation
    A. The problem-solving aproach
        1. Stating and analyzing the problem
        2. Proposing solutions
        3. Selecting and implementing a solution
    B. Participating in group communications
        1. The chairman-duties and qualifications
        2. Rules or order
        3. The panel discussion and symposium
        4. Group investigation

Recommended Laboratory Projects—32 hours

I. Make freehand sketches of horticultural apparatus or laboratory equipment to develop skill in representing distances, proportions, relative sizes, and relationships (4 hours).

II. Construct multiview sketches of mechanical parts requiring simple dimensions and notes (2 hours).

III. Construct freehand sketches of sectional views of a piece of horticultural equipment and show the significant dimensions (2 hours).

IV. Make freehand sketches of certain horticultural features such as a pool, patio, or wall, and record pertinent technical data (2 hours).

V. Write a technical report on some horticultural subject as directed by the instructor (2 hours).

VI. Visit a local horticultural equipment or supply establishment and gather data for a technical report on same (2 hours).

VII. Write the report on this trip using several techniques of exposition (2 hours).

VIII. Do a technical report on some piece or pieces of horticultural equipment under consideration for purchase, from which a decision to purchase or not to purchase can be made (2 hours).

IX. Do a research paper (2 hours).

X. Make a schematic diagram of an irrigation system with dimensions and notes (2 hours).

XI. Make an electrical wiring diagram for a small building or a tractor (2 hours).

XII. As directed by the instructor, prepare a graph, or graphs, to portray certain information (2 hours).

XIII. Prepare charts, diagrams, and graphs to be used in an oral technical report to the class (2 hours).

XIV. Prepare sketches and drawings of some horticultural feature to show the necessary plumbing (2 hours).

XV. Prepare specifications, including diagrams and sketches for a piece of horticultural equipment to be purchased by the department (2 hours).

Texts and References

AMERICAN STANDARD ASSOCIATION. *Drafting Manual.* ASA-Y14.
———. *Graphic Symbols.* ASA-Y32.
BAER. *Electrical and Electronics Drawing.*
BAIRD *and* KNOWER. *Essentials of General Speech.*
———. *General Speech: An Introduction.*
BORDEAUX. *How to Talk More Effectively.*
CROUCH *and* ZETLER. *A Guide to Technical Writing.*
DEAN *and* BRYSON. *Effective Communication.*
FRENCH *and* VIERCK. *Fundamentals of Engineering Drawing.*
GIACHINO. *Drafting and Graphics.*
HARWELL. *Technical Communications.*

Hays. *Principles of Technical Writing.*

Hicks. *Successful Technical Writing.*

Hoelscher *and* Springer. *Engineering Drawing and Geometry.*

Instrument Society of America. *Recommended Practice—Instrumentation Flow Plan Symbols,* ISA-RP5.1.

Kegel *and* Stevens *Communication: Principles and Practices.*

Leven. *Graphics with an Introduction to Conceptual Design.*

Marder. *The Craft of Technical Writing.*

McCrorie. *The Perceptive Writer, Reader, and Speaker.*

Perrin *and* Smith. *Handbook of Current English.*

Rhodes. *Technical Report Writing.*

Roget. *New Roget's Thesaurus of the English Language.*

Schutts *and* Steinberg. *Communication in Business and Industry.*

Souther. *Technical Report Writing.*

Thompson. *Fundamentals of Communication.*

Warriner *and* Griffith. *English Grammer and Composition: A Complete Handbook.*

Witty. *How to Become a Better Reader.*

Young *and* Symonik. *Practical English, Introduction to Composition.*

Zetler *and* Crouch. *Successful Communication in Science and Industry.*

Instructional Aids

National Educational Television Film Service, Audio-Visual Center, Indiana University, Bloomington, Ind. 47405

Person to Person Communication, 13 minutes, 16 mm, sound

National Safety Council, 425 N. Michigan Ave., Chicago, Ill. 60601

It's An Order, 12 minutes, 16 mm, sound

Produced by Hayakawa (Language in Action Series), *Experience as Give and Take,* 29 minutes, 16 mm, sound

Produced by Hayakawa (Language in Action Series), *Talking Ourselves into Trouble,* 29 minutes, 16 mm, sound

Produced by Hayakawa (Language in Action Series), *Words That Don't Inform,* 29 minutes, 16 mm, sound

The Pennsylvania State University, University Park, Penn. 16802

According To Plan: Introduction to Engineering Drawing, 9 minutes, 16 mm, black and white, sound

Freehand Drafting, 15 minutes, 16 mm, black and white, sound

General Courses

BUSINESS ORGANIZATION AND MANAGEMENT

Hours Required

Class, 3; Laboratory, 0

Course Description

A study of the underlying principles of organizing, financing, and management of business enterprises. Specialized business activities such as merchandising, accounting, personnel management, marketing, credit management, and production control are introduced and analyzed from a pragmatic standpoint because the organization and management of business embraces broad and complicated activities, requiring a wide general knowledge as well as much specialization and application of commercial insights.

The assumption is made that whether the horticultural technician owns his own business or works for others he must understand and practice successful business techniques and concepts to succeed in the operation of a business or as an employee.

As the various topics are introduced, the meaning and underlying principles of each and the role each plays in horticultural technology are considered. Special consideration should be given to the establishment and operation of a small busines since it represents the majority of businesses in the horticultural field at present. Students should be encouraged to seek out, examine, and analyze selected horticultural enterprises as to their organizational and managerial effectiveness.

Major Divisions

	Class Hours
I. Introduction to Business and Our Economic System	3
II. Forms of Business Ownership	4
III. The Organizational Structure and Management Processes of Business	6
IV. Tools of Decisionmaking	8
V. Labor-Management Relations	4
VI. Acquisition and Organization of the Factors of Production	10
VII. The Marketing Process	9
VIII. Institutions Affecting Business	4
Total	48

Units of Instruction

- I. Introduction to Business and Our Economic System
  - A. Why business exists
    - 1. Historical need and growth of business
    - 2. Classifications of business organizations
    - 3. Opportunities in the business field
  - B. The American economic system
    - 1. The nature of economics
    - 2. Measures of economic activity
      - a. Gross national product
      - b. National income
      - c. Disposable personal income
      - d. Employment and unemployment
    - 3. Characteristics of modern business
      - a. Specialization
      - b. Interdependence
      - c. Mass production
      - d. Business cycles
- II. Forms of Business Ownership
  - A. The small business enterprise
    - 1. Single proprietorship and partnership
    - 2. Corporations and the joint stock company
    - 3. Business trusts, joint ventures, and cooperatives
  - B. Problems of owning and operating your own business
  - C. Sources of business information
    - 1. Private
    - 2. State
    - 3. Federal
  - D. The small business and the future
- III. The Organizational Structure and Management Processes of Business
  - A. Selecting the form of organization
    - 1. Concepts of organizational planning
    - 2. Formal and informal organizations
  - B. Line and staff function organizational charts
  - C. General management functions
    - 1. Management guides

    2. Qualities of leadership
  D. Office administration
    1. Physical facilities
    2. Office operations
    3. Automation and its affect on the office

IV. Tools of Decisionmaking
  A. Accounting records and business
    1. The function of accounting
    2. Types of data furnished by the accounting department
      a. Income statement
      b. Balance sheet statement
      c. Tax statements
    3. The use of budgets
      a. Analysis of budgets
      b. Budgeting and linear programing
  B. Research and statistics
    1. Research aids in decisionmaking
    2. Forecasting
    3. Use statistical averages (mean, medium, mode)
  C. Risk and uncertainty
    1. Decisionmaking under risk and uncertainty
    2. Uncertainty precautions—defenses against

V. Labor-Management Relations
  A. Personnel management
    1. Job analysis
    2. Employee selection and placement
    3. Employee training
  B. Wage and salary administration
    1. Theory of wages
    2. Methods of wage payments
    3. Fringe benefits
    4. Maintaining high morale
  C. The labor movement today
    1. Growth and development of labor unions
    2. Labor legislation
    3. Collective bargaining
    4. Settlement of labor disputes

VI. Acquisition and Organization of the Factors of Production
  A. The acquisition of capital
    1. The role of capital
    2. The amount of capital to use
    3. The basis for credit
    4. Sources of credit
      a. Security exchanges
      b. Long-term capital securities
      c. Businesses and banks
      d. Public and other sources
  B. The acquisition of a business
    1. Choice of a location
    2. Buying a business
    3. Renting a business
    4. Business plant layout
    5. Costs and returns as related to size of business
  C. Factors of production
    1. Plant operational layout
    2. Characteristics of production
      a. Raw materials purchasing
      b. Inventory control
    3. Production processes
    4. Production control
    5. Horizontal compared to vertical diversification production processes

VII. The Marketing Process
  A. Functions of marketing
    1. Channels of distribution
    2. Supply and demand
  B. Costs of marketing
    1. Pricing in merchandising
    2. Pricing, wholesale and retail levels
    3. Expense control in merchandising and retailing
  C. The consumer market
    1. Customer relations
    2. Merchandising
      a. Retailer
      b. Wholesaler
    3. Service businesses
    4. Characteristics of retailing
      a. Classification of retail outlets
      b. Functions performed by retailer
    4. Market research
  D. Sales management
    1. Personal selling in modern business
    2. Fundamentals of selling
    3. Types of sales organizations
    4. Trends in sales management
  E. Transportation and storage of products
    1. How transportation enhances value
    2. Types of carriers
    3. Storage of products to hit peak market prices
      a. Costs involved
      b. Risks involved

VIII. Institutions Affecting Business
  A. Government and business
    1. The function of government

2. Government regulation of business
3. Government aids to business
4. Taxation

B. Business law and ethics
   1. Modern business and the law
   2. Ethics and morality in business practice
   3. Making business more professional

Texts and References

BECKHARDT. *Business Loans of American Commercial Banks.*

BONNEVILLE *and* DEWEY. *Organizing and Financing Business.*

BROOM *and* LONGENECKER. *Small Business Management.*

COLM *and* GEIGER. *The Economy of the American People.*

EELLS. *The Meaning of Modern Business.*

KELLEY *and* LAWYER. *How to Organize and Operate a Small Business.*

LAZO *and* CORBIN. *Management in Marketing.*

MUND. *Government and Business.*

NEWMAN *and* SUMMER. *The Process of Management.*

SAMUELSON. Economics: *An Introductory Analysis.*

TIMMS. *The Production Function in Business.*

YODER. *Personnel Management and Industrial Relations.*

Instructional Aids

Business Education Films, 4607 16th Ave., Brooklyn, N.Y. 11204

Introduction to Accounting. 35 minutes, 16 mm, sound, black and white

It's Good Business. 35 minutes, 16 mm, sound, black and white

Modern Talking Picture Service, Inc., 235 Stuart St., Boston, Mass. 02116

Credit—Man's Confidence in Man. 30 minutes, 16 mm, sound, color

Small Business, U.S.A.—*The Story of Main Street.* 33 minutes, 16 mm, sound, black and white

The Give and Take. 26 minutes, 16 mm, sound, color

Public Relations Film Library, Ohio Oil Co., 239 South Main Street, Findlay, Ohio 45840

You Decide. 28 minutes, 16 mm, sound, black and white

Victor Keyfetz Production, 1780 Broadway, New York, N.Y. 10019

The Magic Triangle—The Story of Free Enterprise. Filmstrip, black and white

COMMUNICATION SKILLS

Hours Required

Class, 3; Laboratory, 0

Course Description

The course places emphasis throughout on exercises in writing, speaking, and listening. Analysis is made of each student's strengths and weaknesses. The pattern of instruction is geared principally to helping students improve skills in areas where common weaknesses are found. The time allotments for the various elements within major divisions will depend upon the background of the class.

A brief consideration of technical reporting is included early in the course because of its importance in the orientation of the technician, and to his development and use of communication skills.

Major Divisions

	Class Hours
I. Communication and the Technical Specialist	2
II. Sentence Structure	6
III. Using Resource Materials	4
IV. Written Expression	20
V. Talking and Listening	10
VI. Improving Reading Efficiency	6
Total	48

Units of Instruction

I. Communication and the Technical Specialist
  A. Why the technical specialist must be proficient in the art of communication
  B. Why written communication is an essential skill
    1. Statements of facts
    2. Expression of ideas
    3. Technical reporting
      a. Formal
      b. Informal
    4. Use of graphics to illustrate written communications
  C. Why oral communication is an essential skill
    1. Person to person expression of ideas and thoughts
    2. Verbal reporting
  D. Diagnostic tests

II. Sentence Structure
  A. Review of basic parts of speech
  B. What makes complete sentences
  C. Use and placement of modifiers, phrases, and clauses
  D. Sentence conciseness
  E. Exercises in sentence structure

III. Using Resource Materials
  A. Orientation
    1. Use of school library
      a. Location of reference materials (Reader's Guide, and others)
      b. Mechanics for effective use
      c. Dewey Decimal System
    2. Dictionaries
      a. Types of
      b. How to use
      c. Diacritical markings and accent marks
    3. Other reference sources
      a. Technical manuals and pamphlets
      b. Bibliographies
      c. Periodicals
  B. Exercises in use of resource materials
    1. Reader's Guide
    2. Atlases
    3. Encyclopedias
    4. Other

IV. Written Expression (emphasis on student exercises)
  A. Diagnostic test
  B. Paragraphs
    1. Development
    2. Topic sentence
    3. Unity, coherence
  C. Types of expression
    1. Inductive and deductive reasoning
    2. Figures of speech
    3. Analogies
    4. Syllogisms
    5. Cause and effect
    6. Other
  D. Written exercises in paragraph study
  E. Descriptive reporting
    1. Organization and planning
    2. Emphasis on sequence, continuity, and delimitation to pertinent data of information

- F. Letter writing
    - 1. Business letters
    - 2. Personal letters
- G. Mechanics
    - 1. Capitalization
    - 2. Punctuation—when to use
        - a. Period, question mark, and exclamation point
        - b. Comma
        - c. Semicolon
        - d. Colon
        - e. Dash
        - f. Parentheses
        - g. Apostrophe
    - 3. Spelling
        - a. Word division—syllabification
        - b. Prefixes and suffixes
        - c. Word analysis and meaning—context clues and phonetics
- H. Exercises in mechanics of written expression

V. Talking and Listening (emphasis on student exercises)

- A. Diagnostic testing
- B. Organization of topics or subject
- C. Directness in speaking
- D. Gesticulation and use of illustrations
- E. Conversation courtesies
- F. Listening faults
- G. Taking notes
- H. Understanding words through context clues
- I. Exercises in talking and listening

VI. Improving Reading Efficiency

- A. Diagnostic test
- B. Reading habits
    - 1. Correct reading posture
    - 2. Light sources and intensity
    - 3. Developing proper eye span and movement
    - 4. Scanning
    - 5. Topic sentence reading
- C. Footnotes, index, bibliography, cross references, etc.
- D. Techniques of summary
    - 1. Outline
    - 2. Digest or brief
    - 3. Critique
- E. Exercise in reading improvement
    - 1. Reading for speed
    - 2. Reading for comprehension

Texts and References

Baird *and* Knower. *Essentials of General Speech.*

———. *General Speech, An Introduction.*

Beardsley. *Thinking Straight.*

Bordeaux. *How to Talk More Effectively.*

Buckler *and* McAvory. *American College Handbook of English Fundamentals.*

Crouch *and* Zetler. *Guide to Technical Writing.*

Dean *and* Bryson. *Effective Communication.*

DeVitis *and* Warner. *Words in Context: A Vocabulary Builder.*

Gerber. *The Writer's Resource Book.*

Harwell. *Technical Communication.*

Kegel *and* Stevens. *Communication: Principles and Practices.*

Lee. *Language Habits in Human Affairs.*

Macrorie. *The Perceptive Writer, Reader, and Speaker.*

Marder. *The Craft of Technical Writing.*

Perrin *and* Smith. *Handbook of Current English.*

Roget. *New Roget's Thesaurus of the English Language.*

Schutte *and* Steinberg. *Communication in Business and Industry.*

Stewart *and* others. *Business English and Communication.*

Strunk *and* White. *The Elements of Style.*

Thompson. *Fundamentals of Communication.*

Tracy *and* Jennings. *Handbook for Technical Writers.*

Warriner *and* Griffith. *English Grammar and Composition: A Complete Handbook.*

Witty. *How to Become a Better Reader.*

Young *and* Symonik. *Practical English, Introduction to Composition.*

Zetler *and* Crouch. *Successful Communication in Science and Industry.*

Instructional Aids

Coronet Films, Inc., Coronet Building, Chicago, Ill. 60604

Improve Your Punctuation. 11 minutes, 16 mm, sound, black and white or color

National Education Television Film Service, Audio-Visual Center, Indiana University, Bloomington, Ind. 47405

The Definition of Language. 29 minutes, 16 mm, sound. Produced by Henry Lee Smith (Language in Linguistics Series)

Dialects. 29 minutes, 16 mm, sound. Produced by Henry Lee Smith (Language in Linguistics Series)

How to Say What You Mean. 29 minutes, 16 mm, sound. Produced by S. I. Hayakawa (Language in Action Series)

Language and Writing. 29 minutes, 16 mm, sound. Produced by Henry Lee Smith (Language in Linguistics Series)

The Task of the Listener. 29 minutes, 15 mm, sound. Produced by S. I. Hayakawa (Language in Action Series)

What is the Meaning? 29 minutes, 16 mm, sound. Produced by S. I. Hayakawa (Language in Action Series)

DuArt Film Laboratories, Inc., 245 West 53rd St., New York, N.Y. 10019

Effective Writing. 19 minutes, 16 mm, sound, black and white. U.S. Department of the Air Force. Order No. TF 1-5072

Practical English Usage, Lecture I: The Tools of Language. 30 minutes, 16 mm, sound, black and white. U. S. Department of Defense

Practical English Usage I, Lecture 10: Writing Clear Sentences: Making Words Agree. 30 minutes, 16 mm, sound, black and white. U.S. Department of Defense

Practical English Usage I, Lecture 13: Dressing Up Sentences: Parallelism: Avoidance of Shifts. 30 minutes, 16 mm, sound, black and white. U.S. Department of Defense

Practical English Usage I, Lecture 14: Dressing Up Sentences: Word Economy (Word Reduction). 30 minutes, 16 mm, sound, black and white. U.S. Department of Defense

Practical English Usage I, Lecture 15: Dressing Up Sentences, Variation. 30 minutes, 16 mm, sound, black and white. U.S. Department of Defense

Practical English Usage I, Lecture 16: Dressing Up Sentences: Vocabulary. 30 minutes, 16 mm, sound, black and white. U.S. Department of Defense

GENERAL AND INDUSTRIAL ECONOMICS

Hours Required

Class, 3; Laboratory, 0

Course Description

A study of economics designed to impart a basic understanding of the principles of economics and their implications; to develop the ability to follow an informed personal finance program; to aid in the development of intelligent consumption; and to provide an understanding of the underlying relationship of cost control to success in industrial enterprise. The programs or problems worked upon by any technician in either research or production ultimately must be measured by a cost analysis. Awareness of this fact and a knowledge of elementary economics prepare the student for the cost-conscious environment of his future employment. It is suggested that instruction in this course be based on this pragmatic approach and that students be encouraged to study examples from industry as they learn about industrial cost analysis, competition, creation of demand, economic production, and related aspects of applied economics.

Major Divisions

	Class Hours
I. Introduction	2
II. Economic Forces and Indicators	3
III. Natural Resources—the Basis of Production	3
IV. Capital and Labor	3
V. Business Enterprise	7
VI. Factors of Industrial Production Cost	8
VII. Price, Competition, and Monopoly	5
VIII. Distribution of Income	2
IX. Personal Income Management	2
X. Insurance, Personal Investments, and Social Security	3
XI. Money and Banking	3
XII. Government Expenditures, Federal and Local	3
XIII. Fluctuations in Production, Employment, and Income	2
XIV. The United States Economy in Perspective	2
Total	48

Units of Instruction

I. Introduction

II. Economic Forces and Indicators
  - A. Economics defined
  - B. Modern specialization
  - C. Increasing production and consumption
  - D. Measures of economic activity
    - 1. Gross national product
    - 2. National income
    - 3. Disposable personal income
    - 4. Industrial production
    - 5. Employment and unemployment

III. Natural Resources—the Basis of Production
  - A. Utilization and conservation of resources
  - B. Renewable resources
  - C. Nonrenewable resources
  - D. Future sources

IV. Capital and Labor
  - A. Tools (capital)
    - 1. The importance of saving and investment
    - 2. The necessity for markets
  - B. Large-scale enterprise
  - C. Labor
    - 1. Population characteristics
    - 2. Vocational choice
    - 3. General education
    - 4. Special training
    - 5. Management's role in maintaining labor supply

V. Business Enterprise
  - A. Forms of business enterprise
    - 1. Individual proprietorship
    - 2. Partnership
    - 3. Corporation
  - B. Types of corporate securities
    - 1. Common stocks
    - 2. Preferred stocks
    - 3. Bonds
  - C. Mechanics of financing business
  - D. Plant organization and management

VI. Factors of Industrial Production Cost
  - A. Buildings and equipment
    - 1. Initial cost and financing

    2. Repair and maintenance costs
    3. Depreciation and obsolescence costs
  B. Materials
    1. Initial cost and inventory value
    2. Handling and storage costs
  C. Processing and production
    1. Methods of cost analysis
    2. Cost of labor
    3. Cost of supervision and process control
    4. Effects of losses in percentage of original product compared to finished product (yield)
  D. Packaging and shipping
  E. Overhead costs
  F. Taxes
  G. Cost of selling
  H. Process analysis, a means to lower costs
  I. Profitability and business survival

VII. Price, Competition, and Monopoly
  A. Function of prices
  B. Price determination
    1. Competitive cost of product
    2. Demand
    3. Supply
    4. Interactions between supply and demand
  C. Competition, benefits, and consequences
    1. Monopoly and oligopoly
    2. Forces that modify and reduce competition
    3. History of government regulation of competition
  D. How competitive is our economy?

VIII. Distribution of Income
  A. Increasing real income
  B. Marginal productivity
  C. Supply in relation to demand
  D. Income resulting from production
    1. Wages
    2. Interest
    3. Rents
    4. Profits
  E. Income distribution today

IX. Personal Income Management
  A. Consumption—the core of economics
  B. Economizing defined
  C. Personal and family budgeting
  D. Analytical buying
    1. Applying quality standards
    2. Consumer's research and similar aids
  E. The use of credit
  F. Housing—own or rent

X. Insurance, Personal Investments, and Social Security
  A. Insurance defined
  B. Life insurance
    1. Group, industrial, and ordinary life policies
    2. Type of policies—their advantages and disadvantages
  C. Casualty insurance
  D. Investments
    1. Savings accounts and Government bonds
    2. Corporation bonds
    3. Corporation stocks
    4. Annuities
    5. Pension plans
  E. Social Security
    1. Old-age and survivors insurance
    2. Unemployment compensation
    3. Medicare

XI. Money and Banking
  A. Functions of money
  B. The Nation's money supply
  C. Organization and operation of a bank
    1. Sources of deposits
    2. The reserve ratio
    3. Expansion of bank deposits
    4. Sources of reserves
  D. The Federal Reserve System
    1. Service functions
    2. Control of money supply
  E. Federal Deposit Insurance Corporation

XII. Government Expenditures, Federal and Local
  A. Economic effects
  B. Functions of Government
  C. Analysis of Government spending
  D. Future outlook
  E. Financing Government spending
    1. Criteria of sound taxation
    2. Tax revenues in the United States
    3. The Federal and State personal income taxes
    4. The corporate income tax
    5. The property tax
    6. Commodity taxes

XIII. Fluctuations in Production, Employment, and Income
  A. Changes in aggregate spending
  B. Output and employment

- C. Other factors affecting economic fluctuations
    - 1. Cost-price relationships
    - 2. Fluctuations in demand for durable goods
    - 3. Involuntary fluctuation of supply of commodities
    - 4. Economic effects of war
    - 5. Inflation and deflation of currency value
    - 6. Economic effects of inventions and automation
- D. Means of implementing fiscal policy
- E. Government debt
    - 1. Purpose of Government borrowing
    - 2. How burdensome is the debt
    - 3. Problems of debt management

XIV. The United States Economy in Perspective

- A. Recent economic changes
    - 1. Increased productivity and well-being
    - 2. Effects of war and depression
    - 3. New products and industries
    - 4. Increase in governmental controls
- B. Present economic problems of U. S. economy
    - 1. The world market—a community of nations
    - 2. International cooperation
    - 3. Maintenance of prosperity and progress
    - 4. Economic freedom and security
- C. Communism: Nature and control by Soviet State
- D. Fascism
- E. British socialism
- F. Problems common to all economic systems
- G. Special economic problems of the United States

Texts and References

BLODGETT. *Comparative Economic Systems.*
Business Week Magazine.
Consumers' Report.
DONALDSON *and* PFAHL. *Personal Finance.*
DUNLOP. *Automation and Technological Change.*
DYE. *Economics: Principles, Problems, Perspectives.*
EDWARDS. *The Nation's Economic Objectives.*
GORDON. *Economics for Consumers.*
KATONA. *The Mass Consumption Society.*
POND. *Essential Economics: An Introduction.*
REYNOLDS. *Economics: A General Introduction.*
SAMUELSON. *Economics: An Introductory Analysis.*
SCHULTZ. *The Economic Value of Education.*

Instructional Aids

McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York, N.Y. 10036

Basic Economic Concepts. 35 mm, filmstrip—set of four filmstrips, black and white. Average 40 frames each

Business Cycles and Fiscal Policy. 35 mm, filmstrip, black and white

Money, Price, and Interest. 35 mm, filmstrip, black and white

Savings and Investment. 35 mm, filmstrip, black and white

Supply and Demand. 35 mm, filmstrip, black and white

FACILITIES, EQUIPMENT, AND COSTS

General Planning of Facilities

Serious planning of facilities for an ornamental horticulture technology program should be undertaken only after extensive studies and surveys by the school administration and its advisory committee indicates that there is a clear and continuing need for sufficient graduate students trained in a horticultural specialty to justify a program.

The guidelines which follow are intended to be a general guide for administrators and advisers who are considering facilities for a horticultural technology program in relationship to other facilities in the institution.

It is assumed that the contemplated ornamental horticulture program would be added to those of an established institution with facilities which could serve most of the general instructional needs of the ornamental horticulture students. This assumption should perhaps be made with caution because the cost of the special facilities required to provide even the minimum breadth of specialized experience in the fields usually cannot be justified for fewer than 90 to 100 students when the program becomes well established.

Nevertheless, it is assumed here that the institution has the required classroom space and associated facilities to provide all courses required in the curriculum except those needed for the technical specialty courses. It is also assumed that there is an available drafting room and a chemical laboratory which may be adapted as a soils laboratory.

It is assumed that facilities for the technical specialty courses *do not* exist and must be provided. These include the head-house and greenhouse complex, the equipment repair storage building and associated area, and the required grounds for out-of-door plant production, turfgrass culture, and any other related horticultural activities involved in the program.

Five separate horticultural curriculums are outlined in this suggested guide. It is unlikely that any institution would begin a program with enough students, staff, and employment opportunity to support *all five* programs. For purposes of planning the horticultural facilities for any new program it should be recognized that the combination of curriculums which might reasonably be expected to evolve when a program is started will begin with either floriculture or nursery, or both.

Both curriculums require a head-house and greenhouse facilities as well as out-of-door growing space. From either the floriculture or nursery option, or a combination of both, an institution's program may grow to include the landscape development, turfgrass management, and the arboriculture curriculums. These latter curriculums may impose some additions to the initial horticultural facilities required to launch the horticultural program, but most of the facilities which would be needed for them would be included in those for the floriculture and/or nursery curriculums with which the program should begin.

It is doubtful if a turfgrass management program or arboriculture curriculum should be undertaken alone and without the facilities associated with floriculture or the nursery curriculums. Whatever program is established should be broadly supported by a strong local advisory committee.

It is very important that provisions be made to have the minimum required head-house and greenhouse facilities, and out-of-door growing areas when the program begins. While the concept of getting a program started with a token or subminimal set of facilities may be attractive, experience has shown that once a program has been started with less than adequate facilities it is usually almost impossible to get the facilities that are really required for the program.

To start without assurance of at least the *minimum* required facilities is to plan the whole program under a severe and self-defeating handicap. Legitimate expansion can usually be financed after a program is well-established and demonstrating growth but if the program is not equipped sufficiently at the beginning, the growth will not occur.

With resourceful planning some of the campus plantings and landscaping can be used over a period of time to provide good teaching experiences for ornamental horticulture students. Such facilities and their use can furnish only a part of the experiences required and this

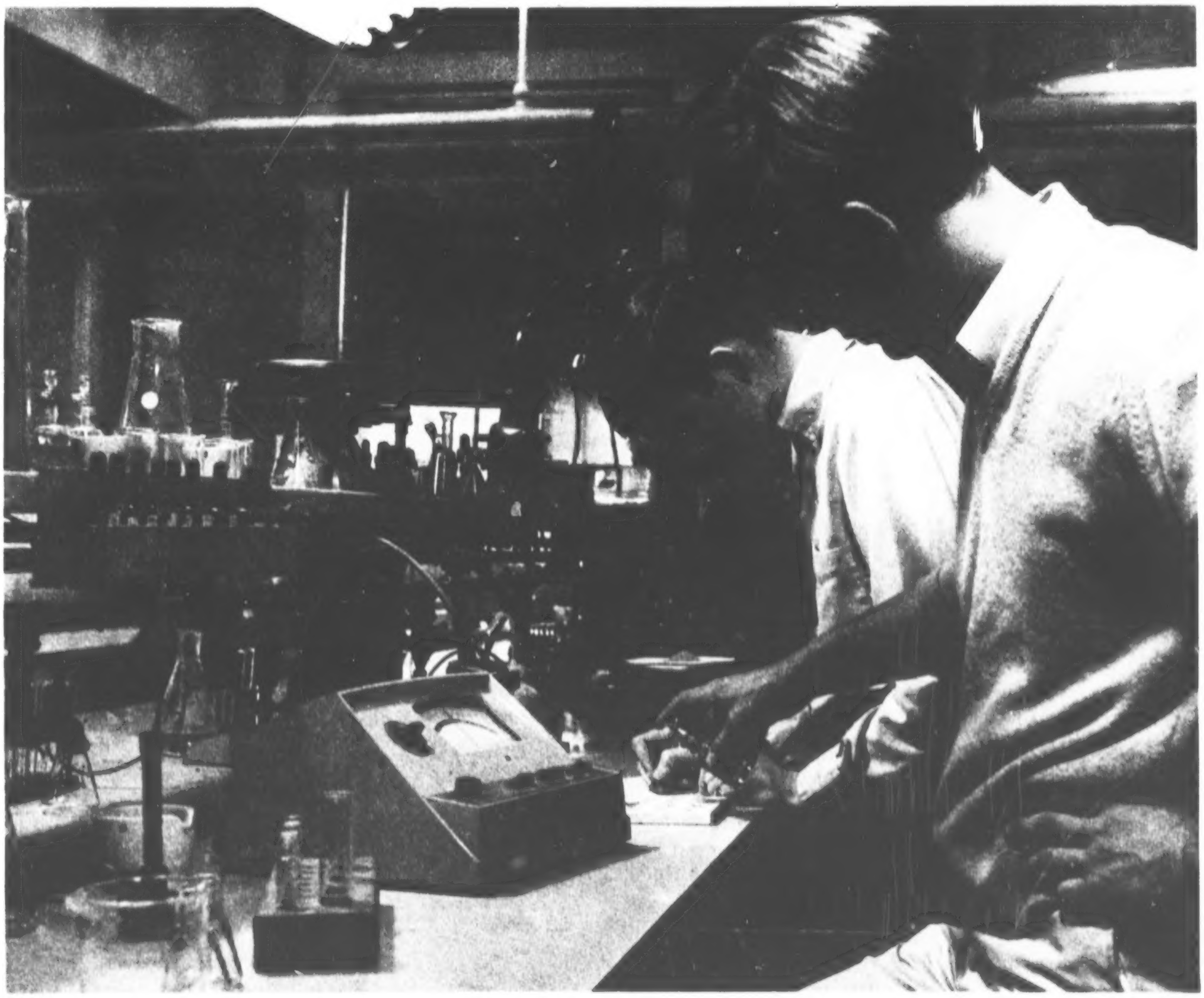

Figure 14.—This well-equipped laboratory is an example of the facilities required to teach a high-quality horticultural soils course.

use must be coordinated with the instructional program employing the facilities and land devoted to the program, and in a sense therefore may be considered to be an additional but not a necessary educational resource.

As the program gets underway some products such as flowers, corsages, and shrubs may be produced and sold, thus lending reality to the floriculture merchandising courses and helping in a small way to defray some expenses of the program. Careful study with the local advisory committee usually can provide arrangements for the sale of such materials on a basis which will be supported by and acceptable to the established florists in the community.

The head-house and greenhouse complex, the equipment storage building, and the grounds set aside for ornamental horticulture purposes should ideally be located adjacent to or reasonably near the classrooms and other educational facility buildings assumed to exist at the outset. Consideration might well be given to locating the ornamental horticulture plant somewhat away from other educational facilities. Some of the commonly used equipment, such as lawn mowers, shredders and mixers, can cause seasonal noise interference. In addition, such a location would provide space for expansion of the curriculum and its activities and at the same time might avoid encroachment by construction of buildings for other purposes not related to horticulture.

Good drainage for the entire ornamental horticulture plant cannot be overemphasized. Much valuable teaching time can be lost when drainage around buildings, in laboratory areas, or even in growing areas, is inadequate.

Land Requirements

The amount of land provided for an ornamental horticulture program may vary depending on the ease with which land can be made available, the expected size of the program 5 or 10 years after it has started, and other factors, such as the extent of the total campus property and its potential use for landscape development and other educational horticultural uses. Landscaped and planted grounds alone should not be considered adequate available land for a horticulture program.

At least 5, but preferably 10 or more, acres of good arable land should be available for a minimum program which does not include extensive turfgrass areas. An area near the greenhouse should be set aside for soil storage and construction of a cloth house, cold frames, and a plastic greenhouse.

In addition, a nursery area should be planned for transplant beds, seed beds, summer propagation beds, cold frames, and lath or shade houses. An outdoor potting area and an area for growing container stock should be planned. A small area for growing nursery stock should be provided to support any nursery management program, and as a source of plants for landscape development programs.

Areas near the horticulture buildings should be so designed that an arboretum, flower gardens, and landscape construction and displays could be integrated and thus provide an outdoor laboratory. These areas should be planned for low maintenance and with fixed irrigation systems.

These outdoor areas cannot be overemphasized as they are a vital part of any horticultural program. Much of the planning, construction, and development of these areas can be done by the students. An important consideration in the development of these areas is that maintenance of them will be required year round.

If turfgrass culture is one of the options, land for grass plots is necessary. Several turfgrass plots of 1,000 square feet each should be planned. These plots would be used as demonstration areas for fertilizer types and rates, mowing heights, seeding rates, identification, and cultural practices. The area should be as level as possible and have a fixed irrigation system.

These plots could be devoted to growing the following grasses; or those more appropriate to a particular geographic region:

6 plots of bluegrasses
4 plots of fescue grasses
6 plots of bent grasses
4 plots of grass mixtures (shade areas, etc.)
3 plots of miscellaneous grasses

A golf course could be included if none were available for students to visit. The purpose of such a course would be to have students become familiar with its management and operation. The maintenance of the golf course would not normally be done by students other than in designated laboratory periods planned for their educational value.

Whatever amount of land is considered to be appropriate for a specific program, it is recommended that the land be owned by the institution, or controlled by a long-term lease. Development of nursery stock or of good educational examples of flower gardens or landscape development projects often requires several years and contributes considerable invaluable educational experience, so the land they occupy must be relatively permanent for the purpose.

Laboratory Facilities and Equipment

The number and size of laboratories and related classrooms, offices, and storage rooms required for teaching ornamental horticulture depend on how many options are offered and the number of students in each option. These facilities can be arranged in many different ways. This discussion will be confined to a floor plan for the head-house and its associated greenhouse ranges (figures 15–19), and the horticulture equipment storage building (figure 20) which might be considered *entirely adequate for a comprehensive ornamental horticulture program in a temperate or cool climate, and offering all five curriculums.*

The building should be constructed to suit the geographic region. If constructed of masonry, it may be more permanent, easily cleaned, and easily heated in a temperate climate than if constructed of other common materials. Little

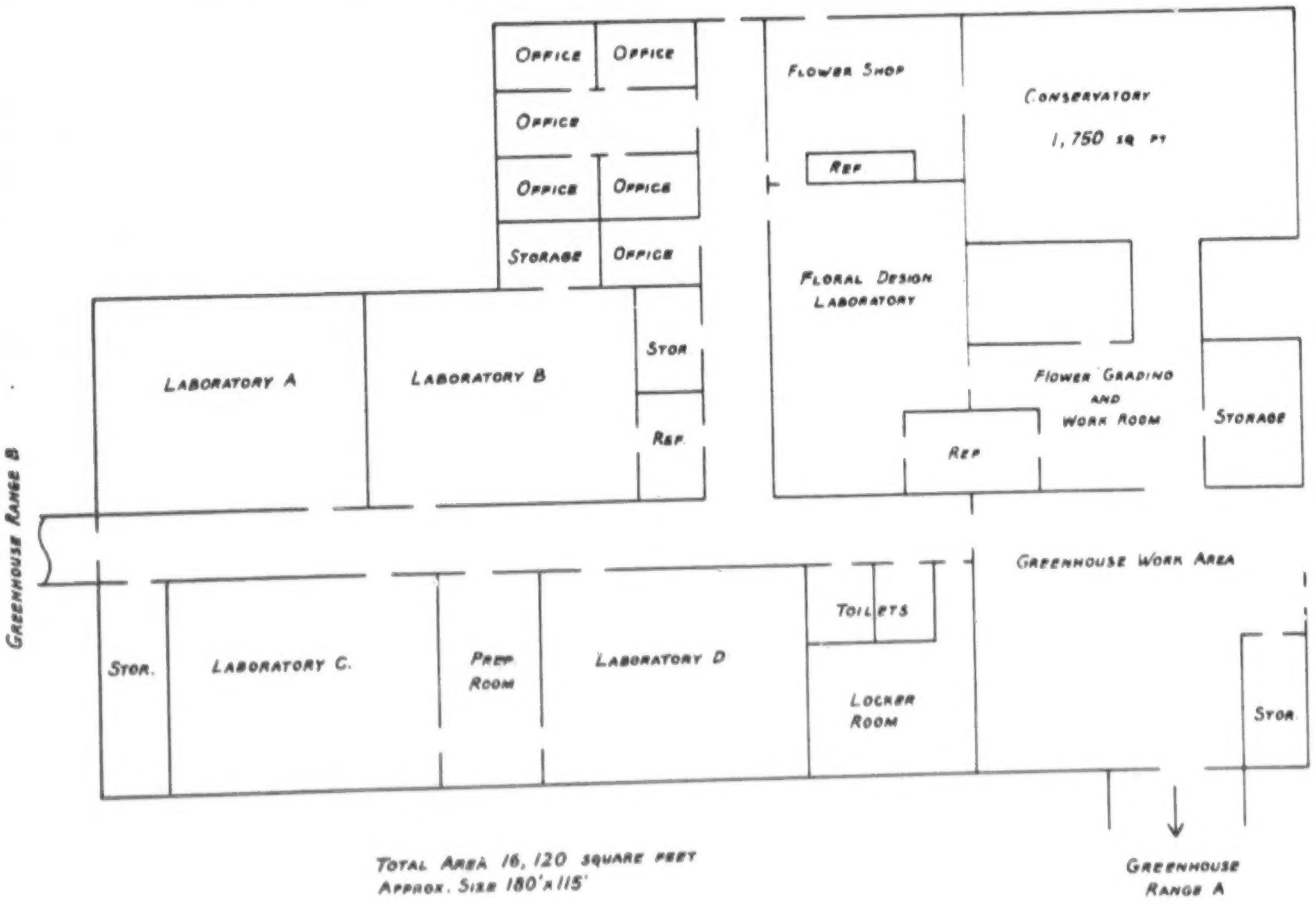
Office
Office
Office
Office
Office
Storage
Office
Flower Shop
Conservatory
1,750 sq ft
Ref
Floral Design
Laboratory
Stor
Ref.
Laboratory A
Laboratory B
Flower Grading
and
Work Room
Storage
Ref
Greenhouse Range B
Greenhouse Work Area
Toilets
Stor.
Laboratory C.
Prep
Room
Laboratory D
Locker
Room
Stor.
Total Area 16,120 square feet
Approx. Size 180'x115'
Greenhouse
Range A

Figure 15.—Suggested floor plan for ornamental horticulture headhouse.

maintenance is required for such a building. The roof could be of the built-up flat type. The floors should be concrete.

Water and Air. Hot and cold water, compressed air, fuel gas, and steam service are required in all laboratories. Service lines for each should be planned for the shortest length of piping consistent with laboratory arrangements. They should be hidden as far as practicable but control points should be planned for safety, accessibility and ease of maintenance. It is recommended that each laboratory have a master control panel with shut-off valve for each utility. This master control panel should have a door with lock so that utilities can be controlled at a central point. An abundant supply of cold water is essential, and must be available for watering plants at many points. Where plants are grown out-of-doors, water for irrigation must be available in most geographic sections of the Nation.

Lighting and Electrical Needs. Classrooms and laboratories should be well-lighted with a recommended minimum of 50 foot candles of light at the table or desk tops. Fluorescent lighting is satisfactory. Incandescent lighting will give ample lighting in storage rooms and toilets.

Electrical services should provide both 110 and 220 volt single-phase electrical service for laboratories. Most equipment used in the laboratory requires 110 volts; occasionally a 220 volt single-phase current is required. In connecting electrical service to laboratory benches, it is suggested that each be connected to a separate circuit breaker. Each laboratory should have a separate master distribution control panel for electrical circuits. Careful thought should be given to placement of electrical outlets so that they will be placed in the most convenient location for use.

Heat and Ventilation. The building should be heated by steam radiators or any other system appropriate to the climate. There usually should be univents with fans in the classrooms and laboratories to allow for the exchange of air. Air conditioning should be provided in climates where it is needed for a major part of the school year. Refrigeration is required in some laboratories. The cooling system and mechanisms should be evaluated carefully when the total facility is planned to provide greatest flexibility and for possible future needs.

Adequate *telephone service* can be an important time saver for the teaching staff in a horticultural laboratory system. Outlets might well be placed at remote ends of the greenhouse and even in the nursery and instructional areas away from the buildings.

Careful planning and good practices to assure the safety of people and property always must be emphasized. Doors must be made large enough and multiple exits must be provided. Mechanized equipment to handle heavy objects should be provided. Safe methods and practices should be taught at all times.

Horticultural equipment, plants and supplies have an attraction to and a ready use by many people. It is prudent to plan facilities to provide reasonable stock control and property security. This can be easily provided and at low cost if considered early enough in the planning stages.

The *flower shop* (see figure 15) is located in the front of the building; it has a separate front entrance and one large window across the front wall. This arrangement allows for much of the front of the shop to be used for window displays. A large section of the walls should be covered with peg board which can be used for displaying merchandise. The shop contains display counters with cabinets below so that this area can be used for storing pottery and merchandise.

A display refrigerator is located at the rear of the shop. The placement of the refrigerator at this location is convenient for placing flowers from the storage refrigerator on display, and for the display of flowers and floral arrangements.

The entrance to the *conservatory* from the flower shop allows for the large display and storage of floral plants during various seasons of the year. The location of the conservatory makes it convenient for students to spend time there learning the characteristics of the plants growing there. Too often the conservatory is in an out-of-the-way place and is not used as much as it should be. Benches or places to sit should be worked into the design.

The cash register and main counter are at the rear of the shop between the conservatory door and refrigerator. A small work table with sink and ribbon bar is in the corner behind the main counter. This area provides work space for students on flower shop duty. This arrangement does not interrupt classes being held in the design laboratory.

The placement of the display counters should be so located that good traffic patterns are formed. The overall plan for the flower shop is to provide the same environment and conditions that a student would find working at a commercial flower shop.

The *floral design laboratory* in figure 15 is adjacent to the flower shop for the convenience of students, faculty, and movement of flowers and supplies. The ceiling should be white and excellent lighting provided. Windows should be on the right wall.

A walk-in cooler at the rear of the room serves as storage space for the flowers and greens which will be used in the design laboratories. Sinks and work space are at the rear of the room; cabinets for storing floral supplies line the left wall.

The *flower grading and work room* is separated from the general greenhouse work room. Grading tables are placed in the center of the room. Sinks, racks for storing water cans and packing supplies, packaging equipment, and carts for moving flowers are located along the walls. A walk-in cooler is at one end of the room, and a general storage room for the floral supplies used in the floral design laboratories and flower shop is at the other end.

The *greenhouse work area room* is at the end of greenhouse range A. Potting benches and soil storage bins are along the walls; the space beneath the benches is used for storing pots, containers, and flats. This work area also contains a stationary power sprayer, proportioners for liquid fertilization, and a steam sterilizer for sterilizing soil and pots.

It has a storage room for chemicals, insecticides, fungicides, and other greenhouse supplies. A sink and work table for mixing sprays and fertilizers should be nearby.

A large overhead door at one end of the room provides easy access to the room for delivering soil, pots, and other supplies. Flowers and floral supplies are easily moved from this entrance to the floral storage room or cooler. During freezing weather, trucks are able to load and unload inside.

Laboratories C and *D* in figure 15 are used for plant propagation, turfgrass management, and greenhouse production courses. Each laboratory should have demonstration table at the front of the room, equipped with air, gas, and water; tables and chairs should be provided for the students. One laboratory-preparation room can be used by both laboratories.

Laboratories A and *B*, also in figure 15, would be equipped with tables and chairs for the students and used for arboriculture, plant identification, nursery management, and herbaceous plants courses.

Laboratory B has a storage room for laboratory displays and supplies, a walk-in cooler at one end of the room for storing plant materials used in the plant identification, plant propagation, and nursery courses.

The storage room at the end of *laboratory C* would house the supplies and equipment used in *greenhouse range B*.

The building also has a locker room in which students may store their books and work clothes. The hallways in the building would provide the space for bulletin boards and displays.

Greenhouse range A (figure 16) would be used for teaching greenhouse production. The greenhouse should be constructed with maintenance and permanency in mind. A steel and aluminum structure would best serve the purpose in a temperate climate. Greenhouses are usually built in standard 35′ x 50′ units such as those shown in figures 16 and 17. Each greenhouse section should be equipped with automatic ventilators, separate temperature control, spray and fertilizer hook-up.

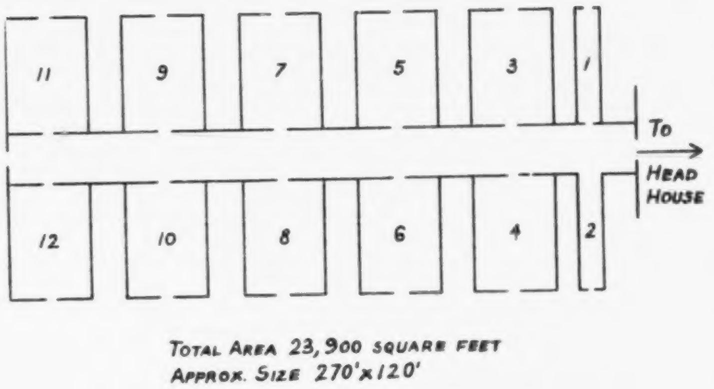

Figure 16.—Suggested layout for greenhouse range A.

The heating system should be steam so that the steam could also be utilized for sterilizing the benches and beds. There has been no area shown for a boiler room, assuming that the steam would be supplied from a central heating plant. If the building were to have its own heating system the boiler room would be located off the greenhouse work area. This location would keep the boiler room and laboratories separated as a safety precaution.

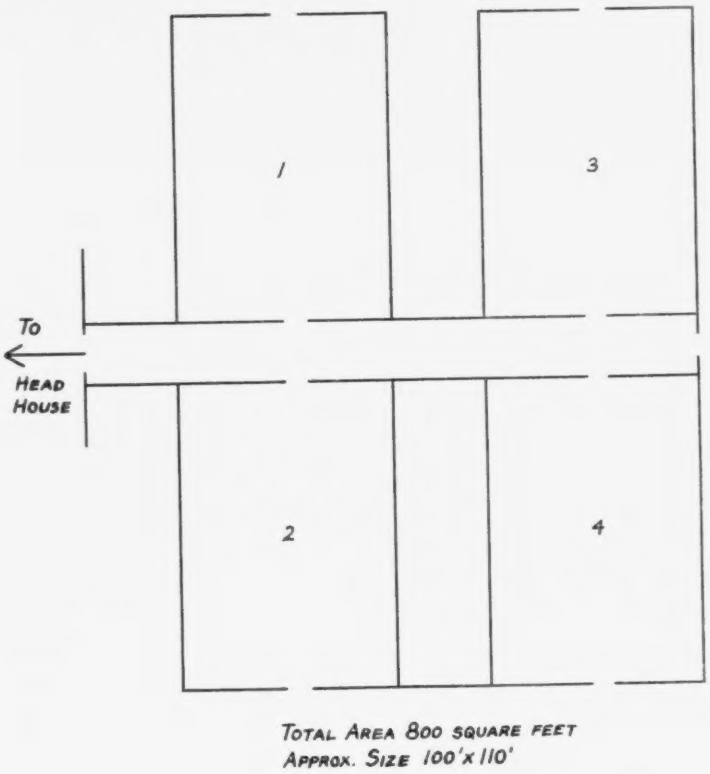

Figure 17.—Suggested layout for greenhouse range B.

Houses 1 and 2 (figure 17) would be used for seed germination and propagation of rooted cuttings. They would be equipped with mist systems, and the heating lines would be placed under the benches.

Houses 3, 4, 5, and 6 (figure 16) would have raised benches for growing pot plants. Geraniums, lilies, chrysanthemums, poinsettias, and miscellaneous plants would be grown in these houses.

Houses 7 and 8 (figure 16) would have raised benches for growing asters, snapdragons, and other miscellaneous crops.

Houses 9 and 10 (figure 16) would have ground beds for the production of roses and chrysanthemums.

Houses 11 and 12 (figure 16) would have raised benches for growing carnations and snapdragons.

The automatic fan and pad cooling systems would be in *houses 7, 8, 9, 10, 11* and *12;* carbon dioxide units would be in some.

The crops grown and number of houses needed would depend upon the type of training the area demanded of the student being trained in greenhouse production.

Greenhouse range B (figure 17) is at the end of the laboratory section of the head house and has the same type houses as *greenhouse range A*. Each house would be equipped with automatic ventilators and temperature controls.

House 1 would have raised benches and would be used by the turf management students; *House 2* would have raised benches and would be used for studies in soil mixtures, nutrients, and other related experiments conducted by the students; and *Houses 3* and *4* would have raised benches and would be used for plant propagation. Each house would have a mist system and heating lines under the benches.

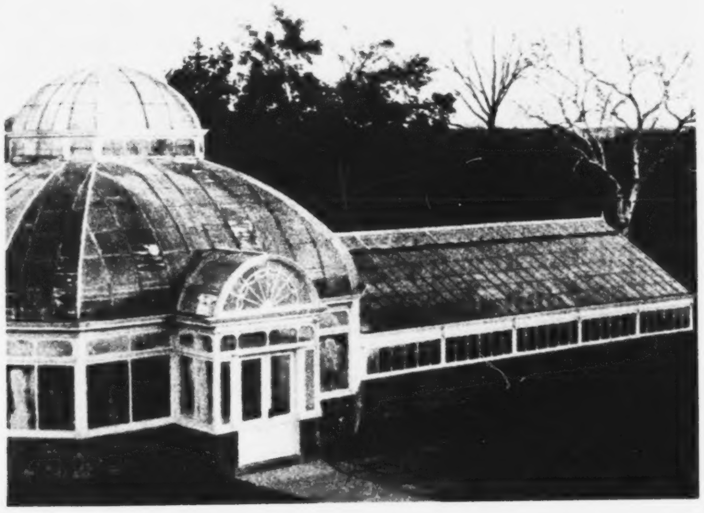

Figure 18.—Adequate greenhouse facilities are essential for any ornamental horticulture technology program. This is part of the greenhouse and conservatory complex at the State University of New York Agricultural and Technical College at Farmingdale.

Suggested office space for staff is indicated in figure 15 and in figure 20. Space should be provided for each instructor and it is recommended that no more than two staff members be located in any office. More than two staff members occupying an office tends to discourage students from approaching instructors for assistance.

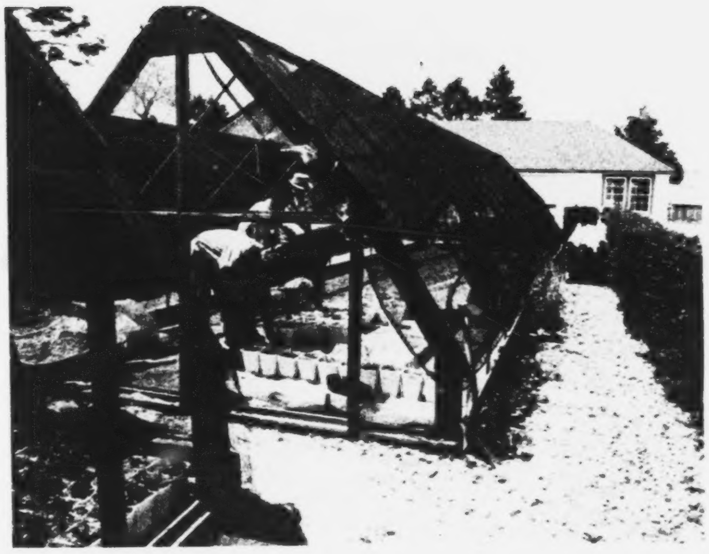

Figure 19.—Plastic greenhouses, made possible by new materials and technology, can supplement but not replace the glass greenhouses required for the nursery management curriculum.

It is desirable to have a waiting room adjacent to staff offices where students can study comfortably while waiting for the instructor's assistance. The waiting room may house the departmental secretary who can arrange conference appointments for students if necessary.

The *Horticulture Equipment and Storage Building* (figure 20) would be similar in construction to the head-house building. Heat would be provided in the hallway, offices, toilets, tool crib, horticulture equipment storage area, and repair, and work area.

The horticulture equipment storage area should have numerous overhead doors to provide easy access. The repair and work area have work benches for working on and repairing the equipment. The tool crib should be enclosed and locked. Tool sets should be stored there and handed out only at laboratory periods. The fertilizer and horticulture storage areas should have bins and built-in shelves to best utilize the space. The hand tools storage area should provide numerous racks and shelves for storing all the hand tools and small equipment used outdoors by the different laboratories.

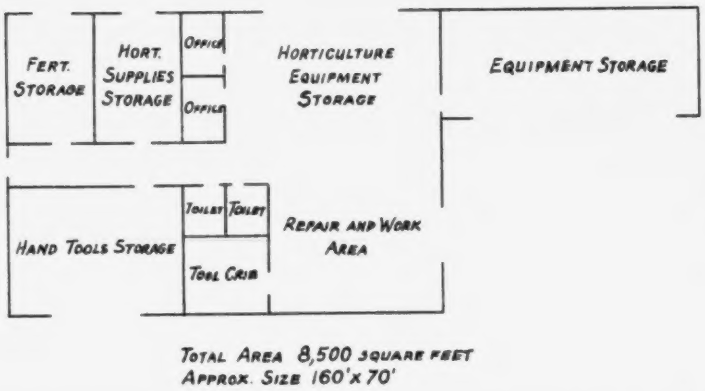

Figure 20.—Suggested floor plan for horticulture equipment and storage building.

It is highly desirable to have a paved, well-drained area adjacent to the equipment and storage building. It provides a place to receive and store heavy materials such as sand, soil, aggregates, cement, flagstone, wallstone, peat moss, fertilizers, pesticides, repair parts, and such supplies; and to load and unload equipment. If part of such area can be under a roof, so much the better. An outdoor work area with good drainage, a solid work surface, and protected from wind, rain and sun is particularly useful.

Cost of Facilities and Equipment

The need for adequate facilities and equipment in horticultural technology programs has already been emphasized. The initial cost of facilities is a major expenditure. The importance of using (a) the combined knowledge of experts on the local advisory committee, which advocates and supports a program, (b) the best available advice from consultants who are a part of an existing and successful ornamental horticulture technician program, and (c) the technical knowledge of the head of the horticultural technology program being planned cannot be overemphasized when cost estimates are made. Each program and its facilities will be different from others because of local or regional employment opportunities, climatic differences, and many other factors.

Five curriculums have been described in this guide for the field of ornamental horticulture. Seldom will an institution find that one curriculum alone will meet the needs of the community. On the other hand it is not economical to attempt to provide too many options, because each is a separate program with technical specialty courses and separate classes. Some combination of curriculums is usually found to be feasible as a beginning program. Determination of the kind of facilities needed and some gross estimate of their cost is necessary in the early stages of program planning.

The following assumptions are made in providing the gross estimating information which follows:

1. Suggested facilities are those considered ideally adequate to teach the option or part of the program to which they apply.

2. Cost estimates are for the facilities or equipment based on 1968 costs in metropolitan New York, and *may vary from 10 to 20 percent* in other areas of the Nation: $10 per square foot for greenhouse, and $12 per square foot for head-house or equipment repair and storage facilities are the basic unit costs used herein. These costs include benches, heating, and the necessary watering, lighting, and ventilating controls. Total costs for some facilities have been rounded to the nearest hundred dollars for simplicity in presentation of data.

3. Complete gross cost estimates are provided for each curriculum separately so individual elements in any curriculum or combination of curriculums can be recognized and used for gross prediction of cost of facilities for a program which combines one or more curriculums.

4. Facilities for each curriculum (and their costs) are provided to accommodate classes of 20 to 25 students per classroom which will result in 2 laboratory sections of 10 to 12 students for both the first and second years of the program. This assumes an enrollment in each curriculum of 40 to 50 students after the second year, with the facilities so planned that 80 to 100 students in each curriculum could be taught.

5. The program can be started for a lower initial expenditure than the gross estimates shown; but definite plans for, and assurance of obtaining adequate facilities soon after the program begins, will be a part of the institution's policy when initiating any program.

6. Although the curriculums are treated separately, flexible use of head-house and equipment repair and storage facilities can provide for multipurpose and multicurriculum use in programs with more than one curriculum.

7. Specific facilities and equipment for *any* program will be acquired only after specialists who are technically competent in the field have made exhaustive studies of the plans and potential suppliers of materials and services. The department head who will be responsible for the program should be deeply involved and carry the major responsibility for final planning and acquisition of facilities and equipment. This will avoid the costly mistakes which often re-

sult if nontechnical personnel attempt to plan and equip technical program facilities.

8. Classrooms, laboratories, lecture rooms, library, and other instructional facilities are assumed to be available for all but the technical specialty classes and laboratory work associated with the program. If a drafting room is not available in the institution a gross estimate of $12,000 may be used to provide one. Similarly, if a chemistry laboratory is not available for the horticultural soils laboratory work, $25,000 may be used as an estimate of its cost.

Basic Curriculum Cost

Some items of equipment and some technical courses are necessary and common to all options. They will be referred to in the cost estimates for each curriculum as *basic curriculum cost*. The following are examples of what may be considered essential and gross estimates of their cost.

AUDIO AND VISUAL AID EQUIPMENT

Item	*Quantity*
Polaroid camera	1
35 mm camera attachments (for micro and macro photography)	1
Film plus processing	
Electronic flash for 35 mm camera	1
Projector	1
Projector table	1
Slide editor or viewer	1
Portable or wall screen	1
30 capacity slide tray	200
Slide cabinets	1
Overhead projector	1

Estimated Cost $3,000

HORTICULTURAL SOILS COURSE EQUIPMENT

Item	*Quantity*
Locker Inventory	24 sets
Beaker 50 ml.	1
Beaker 150 ml.	1
Beaker 400 ml.	1
Bottle, wash, plastic	1
Brush, test tube	1
Burner, Bunsen	1
Clamp test tube	1
Clamp utility	1
Crucible, porcelain	1
Cylinder graduated 10 ml.	1
Cylinder graduated 100 ml.	1
Cylinder graduated, soil testing	1
Flask, Erlenmeyer 150 ml.	1
Flask, Erlenmeyer 250 ml.	1
Funnels, filtering	2
Gauze, wire	1
Dropper, medicine	1
Hydrometer, soil	1
Mortar and pestle	1
Ring 4"	1
Scoopula	1
Support, test tube	1
Support, funnel	1
Spert plate	1
Test tube, soft, 6"	10
Test tube, pyrex, 6"	2
Test tube, flat bottom, 4" x ½"	10
Test tube, flat bottom, 3" x 1"	6
Thermometer 100° C	1
Tongs, crucible	1
Triangle, wire	1
Balance, triple beam	24
Balance, torsion	10
pH Meter, Beckman	6
Centrifuge and safety head	4
Blender, Waring	24
Ovens	3
Sieves No. 10	10
Shaking machine	1
Solubridge soil test equipment	6

Etimated Cost $8,000

HORTICULTURAL APPLICATIONS COURSE EQUIPMENT

Item	*Quantity*
Spade	20
Shovel, round point, and square	20
Scoop	1
Spading fork	20
Manure fork	2
Hay fork	3
Pick	5
Mattock, pick-mattock grub-axe	5
Axe	5
Grub hoe	5
Draw hoe and various kinds	10
Scuffle hoe, dutch	10
Scuffle hoe, diamond point	1
Hand weeders	20
Sickle	5
Scythe	1
Grass whip	2
Grass shears	5
Border shears	2
Halfmoon edger	2
Sod lifter	1
Pruning saw	2
Orchard saw	5
Hand shears	5
Lopping shears	10
Pole saw	5
Pole pruner	5
Trowel	10
Dibble	5
Rakes, wooden	10
Rakes, iron	10
Rakes, broom	20

Wheelbarrow, garden	4
Spreader, hopper	1
Spreader, cyclone	2
Sprayer, portable	1
Hedge shears	6
Electric hedge trimmers 16"	1
Electric hedge trimmers 30"	1
Rotary turf edger	1

Estimated Cost $2,100

WOODY AND HERBACEOUS PLANTS COURSE EQUIPMENT

Item	*Quantity*
Drying oven	1
Freezer	1
Specimen jars and mounts	
Tape writer for labeling	1
Plastic label machine	1
Leaf press	24
Set of blotters	24
Set of ventilators	24
Vasculums	3

Estimated Cost $1,500

Summary of Estimated Costs of Basic Curriculum

Audio and visual aids	$ 3,000
Horticultural soils	$ 8,000
Horticultural applications	$ 2,100
Woody and herbaceous plants	$ 1,500
Total Estimated Cost	$14,600

FLORICULTURE CURRICULUM EQUIPMENT

Item	*Quantity*
Power sprayer, 50 gal.	1
Soil shredder	1
Steam sterilizer for soil	1
Elastic heating cable	5
Automatic mist system	1
Rototiller	1
Greenhouse cooling system (pad and fan)	
Wheelbarrows, garden	4
Handcarts	2
Flomatic watering system	1
Stepladder	2
Garden rakes	20
Water cans	6
Wire cutters	20
Knives	20
Utility shears	20
Sharpening stones	6
Pruning shears	20
Trowels	20
Spades	20
Spading fork	20
Shovel, long handle	20
Tool kit (screw drivers, pliers, saw, and others)	6
Hand sprayer	2
Lightweight duster	1
Wheelbarrow, metal	2
Stapling tacker	1
Stapling plier	1
Water breaker	12
Fog-it nozzle	6
Rose sprinkler	6
Extension handle—watering	2
Liquid fertilizer injector	2
Caulking guns	1
Galvanized flower vases	4 doz.
Gas mask	11
Respirators	3
Gloves, rubber	6 prs.
Raincoats	3
Hats	3
Boots	3 prs.
Display refrigerator 16′ x 4′ x 8′	1
Walk in storage refrigerator 20′ x 12′ x 9′	1
Estimated Total Cost Equipment and Supplies	$ 14,500
Flower shop supplies (vases, containers, ribbon, wire, stands, and others)	$ 1,500
½ Head-house 16, 120 sq. ft. (Figure 15)	$100,000
Conservatory 35′ x 50′	$ 17,500
Greenhouse Range A 23,900 sq. ft. (Figure 16)	$120,000
Basic Curriculum Cost	$ 14,600
Total Estimated Cost	$268,100

LANDSCAPE DEVELOPMENT CURRICULUM—LANDSCAPE PLANS COURSE

Item	*Quantity*
Drafting tables, 31" x 42" and stools	20
Work table, 31" x 42"	1
6′ x 6′ projection screen	1
35 mm slide projector	1
Ammonia process, 42" white (developer printer)	1
100′ Steel engineer's tapes	5
50′ Steel engineer's tapes	5
50′ Steel architect's tapes	5
25′ Steel architect's tapes	5
100′ Metallic cloth tapes	5
Other surveying equipment, levels, and others, listed under "Landscape Surveying"	
Polar planimeters	5
Portable fluorescent tracing board	1
12 drawer plan file cabinets	2
Pantographs	2
24" x 24" cutting table	1
Plastic drawing board covers, 31" x 42"	20
Architect's triangular scale	1
Engineer's triangular scale	1
Magic markers	6
Drafting pencils (complete range)	24
Colored pencils	24
Water color set (brushes and others)	1
Artist's chamois	1
Dry-clean pad	1

Set rapid-o-graph pens	1
Soft rubber erasers	2
Kneaded erasers	2
Protractor	1
Set french curves	1
Set railroad curves	1
Lettering guide	1
India ink	6
Drafting tape	6
14" 30-60° triangle	1
12" 45° triangle	1
Erasing shield	
42" Regular T square	1
42" Reversible head T square	1
24" Sketch pad	
36" Roll study tracing paper	
42" Roll presentation tracing paper (good grade)	
Blackboard, protractor, T square, 30-60° triangle and 45° triangle	
Blackboard pointer	
Drafting dusting brush	
Sand pad	
20' Tree tapes	2
6' Pocket tapes	2
Lettering set	
Rolls ammonia process paper	8
Gal. processing ammonia	4 gals.
Map measuring wheel	

Estimated Cost $4,800

LANDSCAPE CONSTRUCTION COURSE EQUIPMENT

Item	*Quantity*
Hand tools	
Stone forks	2
Sledge hammers, 8 lb.	2
Spalling hammers (dbl. sq. face), 12 lb.	2
Spalling hammers (dbl. sq. face), 16 lb.	2
Spalling hammers (dbl. sq. face), 8 lb.	2
Mattocks, long cutter	6
Picks, railroad, 8 lb.	6
Garden rakes, 14 teeth, level head	12
Square shovels, #2 short handle	12
Spades, short handle	12
Garden wheelbarrows (wooden) pneumatic wheels	4
Shovels #2 short handle, round point	12
Stepladders, 6'-8 step	2
Double pulley, 4" (½" rope)	1
Triple pulley, 4" (½" rope)	1
Double pulley, 8" (1" rope)	1
Triple pulley, 8" (1" rope)	1
Measuring tapes and rulers	
100' steel	4
50' steel	4
25' steel	4
100' metallic	4
50' metallic	4
25' metallic	4
10' steel, pocket	12
Carpenter's level (wooden), 24"	2
Carpenter's level (wooden), 48"	2
Carpenter's level (aluminum), 24"	4
Carpenter's level (aluminum), 48"	4
Line level, 3"	12
Chalk line (Mason's cord), 100' balls	12
Lumber crayon (mixed colors)	6 doz.
Wire scratch brush	6
Bricks, plain carborundum, 8" x 2" x 2"	4
Bricks, fluted carborundum, 8" x 2" x 2"	4
Hand cold chisels	
⅜" x 5"	6
½" x 5½"	6
⅝" x 6¼"	6
¾" x 7"	6
⅞" x 7½"	6
1" x 8"	6
1¼" x 8½"	6
4 pt. star drill, 7/16" x 12"	2
4 pt. star drill, ½" x 12"	2
4 pt. star drill, ⅝" x 12"	2
4 pt. star drill, ¾" x 18"	2
6 brick set, 4" blade	6
Safety goggles	12
Brick hammers	12
Carpenter's claw hammers, 13 oz.	12
Stonecutter's hammers, 3 lb.	12
Claw head hatchets, 4" blade	6
Light side cutting pliers, 5"	3
Lineman's heavy side cutting pliers, 7"	3
Zig-zag wood rule, 6'	12
Zig-zag aluminum rule, 6'	6
Carpenter's squares, 24" x 16"	6
Brick trowels, 19" blade	12
Plasterer's trowels, 11" x 4¾"	3
Pointing trowels	6
Wooden floats, 12" x 4¾"	6
Steel floats, 12" x 4¾"	6
Mortar hoes	3
Edging tool	3
Groover	3
Concrete wheelbarrows	6
Mortar mixing box (wooden) constructed in class	1
Concrete mixer, gasoline powered (½ bag size)	1
One-ton general self-propelled roller	1

Estimated Cost $2,600

LANDSCAPE SURVEYING COURSE EQUIPMENT

Item	*Quantity*
Engineer's steel tapes, 100'	6
Engineer's steel tapes, 50'	6
Locke hand levels	6
Abney hand levels	6
Dumpy levels and tripods	6
Transits and tripods	6
Philadelphia rods	6
Stadia rods	6
Range poles	6 prs.

Surveyor's pins and rings, 14"	6 sets
Plane tables and tripods	6
Alidades (peep-sight types)	6
Surveyor's compasses	6
Pocket magnifying glasses	6
Plumb bobs, 8 oz.	6
Leveling rod levels (1 spirit level-circular)	6
Compensating polar planimeters	6
Surveyor's stake tacks	6 boxes
Stonecutter's hammers, 3 lb.	6
Tree tapes, 20'	6
Pocket tapes, 6'	6
Pantographs	6
Blackboard outfit (triangles, square and straight edge)	1
Estimated Cost $8,100	
Estimated Total Cost Equipment and Supplies	$ 15,500
Landscape Demonstration and Flower Gardens Area—1 Acre:	
Flower Garden display	$ 2,000
Landscape features, fences, pools, walls, and others	3,000
Plant material for arboretum	6,000
Irrigation and drainage	2,000
Total Landscape Demonstration and Flower Gardens Area—1 Acre	$ 13,000
One-half equipment and storage building—figure 4	50,000
Laboratory equivalent to A with offices and storage of head-house—figure 15	70,000
One 35' x 50' greenhouse of range B—figure 17	17,500
Basic Curriculum Cost	14,600
Total Estimated Cost	$180,600

NURSERY CURRICULUM EQUIPMENT

Item	*Quantity*
Spades, digging	20
Shovels, short handle	20
Shovels, long handle	20
Rakes, garden	20
Rakes, fan	20
Rakes, magnesium, 36"	10
Hoes, nursery	20
Hoe, harrow	5
Hoe, Dutch scuffle	5
Fork, spading	20
Fork, pitch	3
Bar digger	2
Mattock	20
Hatchets	3
Axe	1
Sledge, 6 lbs.	1
Lopping shears	6
Pruning saws	10
Pruning shears	20
Knives, budding	20
Towing chain	1
Balling platforms	3
Hedge shears	6
Hedge shears, electric	2
Hand trowels	10
Power chain saw	1
Lining out chain	3
Tree rollers	5
Nursery hand truck	1
Roller, lawn	1
Garden wheelbarrow	4
Metal wheelbarrow	2
Cyclone spreader	2
Hopper spreader	1
Power grinding wheel	1
Rototiller, 20"	1
Rototiller, small	1
Mist sprayer, portable	1
Power auger	1
100 gal. sprayer	1
Balling machine	1
Small tractor—3 point hitch	1
Attachments: Cultivator	1
Plow	1
Disc	1
Root pruner	1
Trailer	1
3½ ton truck with a dump body and power winch	1
Refrigerator—hot to cool temperature control	3
Mist systems	1
Heating cables and controls	3
Gas cans, 2½ gal.	2
Oil cans	4
Grease gun	1
Set of carpentry tools	2
Tool Set:	1
Power drill, ¼"	
Power saw	
Vise	
Wrenches, and others	
Rubber hose, 75'	3 rolls
Polyethylene film, black and clear	6 rolls
Grafting charts	2
Weed mounts	1 set
Grafting twine	4 rolls
Grafting wax	10
Grafting lantern melter	1
Twine, 3 ply, 50 lbs.	1 roll
Burlap, 20"	500 ft.
Burlap, 24"	500 ft.
Burlap, 30"	1,000 ft.
Burlap, 36"	500 ft.
Burlap, 42"	100 ft.
Tree wrap	5 rolls
Jute rope, ¾"	25 ft.
Jute rope, ¾"	50 ft.
Sharpening stones	6
Can shear	1
Tree caliper drescher	1
Till grader	1
Balling nails	50 lbs.
Nail container	1

Hay ring stapling pliers	1
Tape writer plus tape	1
Estimated Total Cost Equipment and Supplies	$ 16,100
Nursery Outdoor Area—2 Acres	$ 2,000
Soil improvement	
Irrigation	
Drainage	
Propagation and Growing Area—½ Acre:	
Seed and transplant bed	$ 300
Cold frames, 100′	500
Plastic greenhouse, 15′ x 100′	500
Shade house, 15′ x 50′	300
Irrigation and drainage	1,000
Total Propagation and Growing Area	$ 2,600
One-Half Equipment and Storage Building—figure 20	$ 50,000
Laboratory Equivalent to A and B with Offices and Storage of Head-house—figure 15	70,000
One 35′ x 50′ Greenhouse of Range B—figure 7	17,500
Basic Curriculum Cost	14,600
Total Estimated Cost	$172,800

TURFGRASS CURRICULUM EQUIPMENT AND TOOLS

Item	*Quantity*
Equipment identical to turf Management III with the following additions:	
Golf course greens mower, 22″	1
Fairway 7—gang reel mower (self-propelled)	1
This unit used for campus areas as well as for instructional purposes.	
Combination scarifier, scraper and leveler	1
Seeder and roller for 3-point tractor hitch	1
Gasoline powered soil shredder	1
Tractor with 3-point hitch, PTO, 10 speed	1
Disc harrow with 3-point hitch	1
Self-propelled trenching machine	1
24″ gravity feed fertilizer spreader	3
36″ gravity feed fertilizer spreader	3
Centrifugal type fertilizer spreader	3
Rotary mower, 21″	1
Hand reel type mowers, 18″	5
Self-propelled "gang" reel type mower, 6′	1
Self-propelled reel type mower, 21″	2
"Hammer-Knife" type mower, 24″	1
Rotary tiller, 16″	1
Self-propelled soil aerator	1
Self-propelled vertical type mower	1
Power edger	1
24″ lawn water-filled roller, 300 lbs.	1
Self-propelled sod cutter	1
Garden wheelbarrow (pneumatic wheels)	3
Garden rake, 14 teeth and level head	12
Square shovel, No. 2 short handles	12
Mattocks, long cutter	6
Shovel, No. 2 short handle and round point	12
Magnesium lawn rake, 24″	12
Magnesium lawn rake, 36″	6
Magnesium lawn rake, 48″	3
Lawn fan rake, 24″	6
Wooden lawn rake, 24″	6
Stone fork	2
Garden digging fork	6
Master socket wrench series	5 sets
Adjustable wrench series	5 sets
Miscellaneous tools (screwdrivers, pliers, ballpeen hammers and others)	5 sets

Estimated Total Cost $20,500

LABORATORY EQUIPMENT

Item	*Quantity*
Seed germination unit	1
Stereo binocular magnifying units, 50 power	20
Laboratory table lamps, 10 tables, two students per table	20
Station laboratory tables and low stools	20
Hand lenses*	20
Dissecting kits (botany)*	20

*Students should purchase

Estimated Cost $8,500

GOLF COURSE—9 HOLE

Construction costs:

Construct 9 greens
Construct 9 tees
Construct fairways
Develop water system
Miscellaneous
Equipment building
Engineering fee
Legal fee
Contingencies
Estimated Cost $28,000

Estimated cost—turfgrass option equipment and tools	$ 20,500
Estimated cost laboratory equipment	8,500
Estimated cost golf course—9 hole	28,000
One-half equipment and storage building—figure 20	50,000
Laboratory equivalent to C and D with Offices and storage of head-house—figure 15	70,000
Two 35′ x 50′ greenhouses of range B—figure 17	35,000
Turf demonstration area—25,000 sq. ft.—soil improvement and irrigation and drainage	2,500
Basic Curriculum Cost	14,600
Total Estimated Cost	$229,100

ARBORICULTURE CURRICULUM EQUIPMENT

Item	*Quantity*
Pole saws, 12′	10
Pole pruners, 12′ complete	10
Saw sheaths	10
Lopping shears	5
Hand pruners	10

Flexible rake	5
Broom, street	5
Treet paint cans	10
Mechanic's tool set	1
Tool locker	1
Rope manila, ½", 800'	1 coil
Rope manila, ⅝", 300'	1 coil
Rope manila, ⅜", 600'	1 coil
Rope manila, ¾", 150'	1 coil
Safety saddle	6
Tree paint	24 gals.
Friction tape	12 rolls
Brush clipper, 8" capacity	1
Hydraulic sprayer, 600 gals	1
Hand saws, pruning	10
Tree surgeon's ladder	1
Square shovel	3
Round point shovel	3
Tree wrap	12 rolls
Pulaski axe	1
Pruning knives	10
File set	4
Tree surgeon's chisels, 1"	10
Tree surgeon's chisels, 1½"	10
Tree surgeon's gauges, 1"	10
Tree surgeon's gauges, 1½"	10
Mallet, 40 oz.	6
Mallet, 24 oz.	6
Bit brace	2
Bit brace, 18"	2
Bit brace, 24"	2
Ship auger bits, various sizes	
Pliers, linemens	6
Axes	5
Hacksaw frame and blades	3
Crescent wrenches. 12"	3
Bolt cutters	2
Steel tape, 50'	2
Cable, 3/16"	250'
Cable, ¼"	250'
Cable, 5/16"	250'
Lag screws hook, 5/16"	100
Lag screws hook, ⅜"	100
Lag screws hook, ½"	100
Screw rod, ½" x 12'	2
Screw rod, ⅝" x 12'	2
Screw rod, ¾" x 12'	2
Screw rod nuts, ½"	25
Screw rod nuts, ⅝"	25
Screw rod nuts, ¾"	25
Diamond washers	100
Thimbles	100
Turnbuckles	100
Lightning protection materials	1 set
Gasoline cans, 5 gal.	1
Gasoline cans, 2½ gal.	2
Electric drill	1
Earth auger bit, 2"	2
Hand earth auger	3
Crow bar, 5'	3
Chain saw, lightweight, gas	1
Chain saw, electric	1
Chain saw, medium weight, 24" bar, gas	1
Electric cord, heavy duty	100'
Sledge hammer, 8 lbs.	2
Increment borer	2
Ballpeen hammer	1
Bench vise	1
Root feeding needle	1
Climbing iron with straps	1
Snatch block, 6"	1
Axe stones	5
Bench stones	3
Electric handrill, ¼" chuck	1
Set of drills	1
Pulley blocks	1
Felling wedges, wood	6
Wedges, 64 lbs., iron	6
Estimated total cost equipment and supplies	$ 13,200
One-half equipment and storage building—figure 20, 8,500 square feet	50,000
Laboratory equivalent to A and B with offices and storage of Head-house—figure 15	70,000
Two 35' x 50' greenhouses of range B—figure 17	35,000
Basic Curriculum Cost	14,600
Total Estimated Cost	$182,800

Horticulture Complex With All Five Curriculums

The purpose of the following summary, which shows the consolidated costs of the five curriculums in the ornamental horticultural program, is to display the costs of the facilities (figures 15, 16, 17, and 20) if equipped ideally but not extravagantly.

It is unlikely that a beginning program would be large enough or varied enough to require all the items in the summary, but those elements necessary to most beginning programs can be identified and extracted from the summary, with an understanding of their relationship to other factors in a program.

HEAD-HOUSE (figure 15)		$200,000
GREENHOUSE—Range A (figure 16)		240,000
GREENHOUSE—Range B (figure 17)		80,000
GREENHOUSE—Conservatory (figure 15)		17,500
EQUIPMENT AND STORAGE BUILDING (figure 20)		100,000
Basic Curriculum Cost		14,600
Outdoor Facilities Cost		17,600
ARBORICULTURE CURRICULUM		
Equipment and Supplies		13,200
FLORICULTURE CURRICULUM		
Equipment and Supplies	$14,500	
Flower Shop Supplies	1,500	16,000
LANDSCAPE DEVELOPMENT CURRICULUM—Equipment and Supplies		15,500
NURSERY CURRICULUM		16,100
TURFGRASS CURRICULUM		
Equipment and Supplies	$20,500	
Laboratory Equipment	8,500	
Golf Course	28,000	57,000
Total Estimated Cost of Horticultural Complex With Five Curriculums		$787,500

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NOTE: *Current edition* after a reference indicates that the publication has undergone one or more revisions.

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APPENDIX

Selected List of Professional and Technical Societies and Organizations Concerned with Ornamental Horticulture and its Application

A selected list of professional and technical societies and associations concerned with ornamental horticulture and its application can be a helpful source of instructional information and reference data. The compendium which follows is not a complete listing; inclusion or omission of an organization does not imply approval or disapproval. This listing omits details regarding local chapters or sections, but educators may obtain additional information by writing directly to the executive secretary of an organization.

AMERICAN ASSOCIATION OF BOTANICAL GARDENS AND ARBORETUMS, Department of Horticulture, New Mexico State University, Box 530, University Park, N. Mex. 88070

History: Organized September 1940

Purpose: To promote the intersts of botanical gardens and arboretums, and public, including municipal, interest in living plants

Total Membership: 200

Publications: *Newsletter,* quarterly

AMERICAN ASSOCIATION OF NURSERYMEN, INC., 835 Southern Building, 15th and H Streets, NW., Washington, D.C. 20005

History: Organized 1875, incorporated 1898

Purpose: To improve conditions in the nursery community through any lawful means which may be appropriate, including without limitation the following: the cultivation of acquaintanceship; fostering and promoting a greater use of nursery products; the improvement and standardization of nursery products; the advancement of fair trade practices, customs and usages; cooperation with allied interests; promoting the arbitration of disputes; the compilation and dissemination of scientific information to members; the study of business methods and standards for recommendation to and use by members; gathering, analyzing and disseminating information of general interest, and securing and presenting the view of the membership to the public, to governmental agencies, and to other organizations; cooperating with governmental agencies in molding policies on legislative and administrative matters in the interest of the public and industry; promoting the exchange and sale of nursery stock; the exhibition of plants, fruits, flowers, or other articles produced by or used in the nursery community; engaging in any lawful activities which will enhance the efficient and economic progress of the nursery community and appraise the public of its scope and character.

Membership: Over 1,300 members in 50 States, the District of Columbia, and Puerto Rico.

Publications: *Monthly Newsletter, Dividends, Merchandise and Sales Bulletin* and *Legislative Reports* to members; also *Plant Patents* (-1542), *How to Name a Plant,* and various leaflets for vocational guidance, on landscape materials, etc. Several 16 mm sound films are available for club programs.

Awards: Norman J. Coleman award for horticultural progress through research; annual industrial landscaping award for an outstanding job of landscape design, and beautification of the grounds of an industrial firm or institution.

AMERICAN FORESTRY ASSOCIATION, 919 17th Street, NW., Washington, D.C. 20006

History: Organized April 1882 in Cincinnati, Ohio, as the American Forestry Congress, joined at the Montreal meeting in August 1882 by an earlier American Forestry Association organized in Chicago in 1875; name changed to present title 1889; incorporated January 1897, reincorporated January 1920 in the District of Columbia.

Purpose: To promote the advancement of intelligent management and use of the country's forests and related resources of soil, water, wild life, and outdoor recreation.

Total Membership: 40,000

Publications: *American Forests,* monthly

AMERICAN HORTICULTURAL SOCIETY, INC., 1600 Bladensburg Road, NW., Washington, D.C. 20002

History: Organized 1922; united in 1926 with the National Horticultural Society; merged with American Horticultural Council in 1960.

Purpose: To accumulate, increase, and disseminate horticultural information.

Total Membership: 4,500

Publications: *American Horticulture Magazine,* quarterly; *Gardener's Forum,* eight times a year

AMERICAN INSTITUTE OF PARK EXECUTIVES, INC., Ogleybay Park, Wheeling, W. Va. 26003

History: Organized 1898 as New England Association of Park Superintendents; name changed to American Association of Park Superintendents 1904; reorganized and name changed to present title 1921; incorporated 1925.

Purpose: To promote the gathering and dissemination of information concerning public parks, gardens, and other recreation grounds, facilities, and programs; to promote increase of such facilities and their greater utilization.

Total Membership: 3,872

Publications: *Parks and Recreation,* monthly; *Management Aids Bulletin,* monthly

AMERICAN RHODODENDRON SOCIETY, 3514 North Russet Street, Portland, Ore. 97200
History: Founded in 1944
Purpose: To disseminate information on rhododendrons and azaleas, operate test gardens, and register names of new hybrids.
Total Membership: 1,800 members in 16 chapters
Publications: *Quarterly Bulletin; Rhododendrons* (1956), *Rhododendron Test Garden*

AMERICAN ROSE SOCIETY, 4048 Roselea Place, Columbus, Ohio 43200
History: Organized in 1889, first as an organization to serve commercial and cut flower growers, later changed to serve amateur rosarians
Purpose: The encouragement of agriculture and horticulture and especially to increase the general interest in the cultivation and improve the standard of excellence of the rose for all people
Membership: About 17,000 members with more than 350 affiliated and associated clubs in 17 regions
Publications: *American Rose Magazine,* monthly; *American Rose Annual; Guide for Buying Roses; List of Public and Private Gardens; Listing of books in Society's Lending Library;* periodic publications of other books and leaflets

AMERICAN SEED TRADE ASSOCIATION, Southern Building, Suite 803, 1030 15th Street, NW., Washington, D.C. 20005
History: Founded 1883
Purpose: Breeders, growers, assemblers, conditioners, wholesalers, retailers of grain, grass, vegetable, flower and other seeds for planting purposes. Special Committee: National Garden Bureau Divisions: Garden seed; Farm seed, Hybrid corn, Lawn and Turf Grass, mail order, packet seed, brokers, retail, associates.
Total Membership: 725
Publications: *Yearbook*

AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, Department of Horticulture, Michigan State University, East Lansing, Mich. 48823
History: Organized 1903
Purpose: To promote the science of horticulture
Total Membership: 2,750
Publications: *Proceedings,* semiannual

AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, Department of Horticulture, Michigan State University, East Lansing, Mich. 48823
History: Organized 1903
Purpose: To promote the science of horticulture
Total Membership: 2,750
Publications: *Proceedings,* semiannual

AMERICAN SOCIETY OF LANDSCAPE ARCHITECTS, INC., 2000 K Street, NW., Washington, D.C. 20006
History: Organized 1899; Incorporated 1916
Purpose: To advance education and skill in the art of landscape architecture as an instrument of service in the public welfare.
Total Membership: 2,376
Publications: *Landscape Architecture,* quarterly; *Landscape Architectural News Digest,* monthly

AMERICAN SOCIETY OF PLANT TAXONOMISTS, Department of Botany, University of California, Berkeley, Calif. 94720
History: Founded in 1937. Member society of American Institute of Botanical Sciences and affiliate of American Association for the Advancement of Science.
Purpose: To broaden the base of knowledge upon which taxonomy rests and to lead in the integration of taxonomy with other branches of botany.
Total Membership: 630
Publications: *Brittonia,* quarterly; *Taxonomic Index,* irregular

GARDEN CLUB OF AMERICA, 598 Madison Avenue, New York, N.Y. 10022
History: Founded 1913; Incorporated 1923
Purpose: The club is especially active in fields of conservation. Scholarships for nature camps are given to local teachers by member garden clubs. Conservation Week observance has been secured in States. The club is concerned with the preservation of the natural beauty of the country and its native plants and animals. Support has been given to legislation regarding conservation and also to highway beautification.
Total Membership: 12,000
Publications: *The Bulletin,* bimonthly

GOLF COURSE SUPERINTENDENTS ASSOCIATION OF AMERICA, 3158 Des Plaines Avenue, Des Plaines, Ill. 60018
History: Organized April 1923 as the Cleveland Greenskeepers Association; founded in September 1926 as the National Association of Greenskeepers of America; incorporated in May 1928 by the State of Delaware; name changed to present title 1951.
Purpose: To promote research and the interchange of scientific and practical knowledge relating to the care of golf courses and turfgrass operations, thus bringing about more efficient and economical operation of golf courses and increased prestige for this Association and its individual members, as well as the occupation of golf course supervision, including the production, maintenance and improvement of turfgrass; to encourage cooperation with other associations and organizations whose interests parallel or complement those of this Association and to promote justice, benevolence and education to and for its members.
Total Membership: 2,437
Publications: *The Golf Superintendent,* monthly; *Membership Directory,* annual; *Newsletter,* quarterly

HOLLY SOCIETY OF AMERICA, INC., P. O. Box 8445, Baltimore, Md. 21234
History: Incorporated 1947
Purpose: To bring together persons interested in any phase of holly; to collect and disseminate practical information; to locate and preserve, if possible, holly stands of extraordinary natural beauty; to promote research in the various cultural and physiological aspects of growing holly; to establish a central place where individuals may secure reliable information on holly.
Total Membership: 1,025
Publication: *Bulletin,* annual; *Holly Letter,* irregular; and bulletins related to holly culture.

INTERNATIONAL PLANT PROPAGATOR'S SOCIETY, Rutgers The State University, Department of Horticulture, New Brunswick, N.J. 08903

History: Organized November 1951

Purpose: To stimulate interest in the growing of finer plant material and to disseminate knowledge of how such material may best be propagated.

Total Membership: 650

Publications: *Proceedings*, annual

INTERNATIONAL SHADE TREE CONFERENCE, 1827 Neil Avenue, Columbus, Ohio 43210

History: Founded 1924

Purpose: To promote and improve the practice of arboriculture and to promote public education to develop a greater appreciation of the value of arboricultural practices.

Total Membership: 1,850

Publications: *Arborists' News*, monthly; *Annual Proceedings of the Conference*, annually; various special publications on arboriculture, irregular

MEN'S GARDEN CLUBS OF AMERICA, 50 Eaton Street, Morrisville, N.Y. 13408

History: Founded in 1932

Purpose: To promote plant-testing programs for members—annuals, begonias, chrysanthemums, daffodils, lawn grasses, iris, lilies, roses, vegetables, and camellias. Seed and plant exchange programs. Training of accredited judges. Films and slides available; program aids supplied to clubs. Speakers' bureaus maintained by regions. Sponsors of Industrial Beautification Contest.

Total Membership: 12,000 members; 300 member clubs, grouped in eight regions

Publications: *The Gardener*

NATIONAL ARBORISTS ASSOCIATION, P. O. Box 426, Wooster, Ohio 44691

History: Founded in 1938

Purpose: To promote greater appreciation of shade trees and to assist the tree care industry in the practice of tree preservation through the dissemination of useful information, encouragement of sound legislation, promotion of research, cooperation with allied industries, insistence upon equitable principles in regard to shade tree work, and the carrying out of an informative public relations program.

Total Membership: 190 members, companies or organizations doing commercial shade tree service work

Publications: Occasional newsletters and special publications for membership

NATIONAL ASSOCIATION OF GARDENERS, INC., 194 Old Country Road, Mineola, N.Y. 11501

History: Organized 1900; Incorporated July 22, 1911

Purpose: To unite all professional gardeners and others interested in gardening; to promote their general welfare by furnishing information pertaining to gardening; to supply them with a medium to secure employment.

Total Membership: 1,200

Publications: *Professional Gardener*, monthly

NATIONAL COUNCIL OF STATE GARDEN CLUBS, INC., 4401 Magnolia Avenue, St. Louis, Mo. 63100

History: Incorporated 1929

Purpose: To coordinate the interests of the State federations of garden clubs; to aid in conservation of natural resources; to promote civic beauty and roadside improvements; to advance the art of gardening and the study of horticulture. National gift scholarships are awarded to further horticultural education and landscape design; 25 awards are given for horticultural achievement.

Membership: About 490,000 members in over 15,000 garden clubs united in 46 State federations and the District of Columbia

Publications: *The National Gardener*, bimonthly; *Directory and Handbook*, biennially

NATIONAL LANDSCAPE NURSERYMEN'S ASSOCIATION, P. O. Drawer 281, Leesburg, Fla. 32748

History: Founded 1939

Purpose: Landscape nurserymen and landscape architects

Total Membership: 275

Publications: *NLNA News Notes*, monthly

NATIONAL PARKS ASSOCIATION, 1300 New Hampshire Avenue, NW., Washington, D.C. 20036

History: Founded 1919

Purpose: The Association, through its board members and cooperating organizations, works with horticultural groups in furtherance of joint aims. Educational projects: work with teachers and students on conservation matters; student conservation program, an experimental venture, designed to test the feasibility of utilizing volunteer student assistance to supplement the manpower shortage in the national parks during the summer months.

Publications: *National Parks Magazine*, monthly; film rental library; sets of slides of the national parks for sale.

SOCIETY OF AMERICAN FLORISTS, Suite H-220, Sheraton Park Hotel, Washington, D.C. 20008

History: Founded 1884

Purpose: Growers, wholesalers, retailers and allied tradesmen in the floral industry

Total Membership: 3,400

Publication: *Dateline*, monthly

SOCIETY OF AMERICAN FORESTERS, Suite 300, 1010 16th Street, N.W., Washington, D.C. 20036

History: Organized November 1900

Purpose: To represent, advance and protect the interests and standards of the profession of forestry; to provide a medium for exchange of professional thought; and to promote the science, practice and standards of forestry at an accredited college or university.

Total Membership: 15,500

Publications: *Journal*, monthly; *Forest Science*, quarterly

UNITED STATES GOLF ASSOCIATION, 40 East 38th Street, New York, N.Y. 10016

History: Organized in 1894

Purpose: To carry on the fine things of golf: fair play, good fellowship and the general good of the game; sponsorship of turfgrass research by State and regional agricultural experiment stations; development of trained workers in turf management.

Total Membership: Over 8,000 Regular Member Clubs and Associate Membership Courses.

Publications: *USGA Golf Journal*, eight times a year; *USGA Green Section Record*, six times a year

WOMAN'S NATIONAL FARM AND GARDEN ASSOCIATION, 3017 Military Road, Washington, D.C. 20015

History: Founded 1914

Purpose: To stimulate interest in horticultural therapy; to cooperate with governmental agencies for the improvement of rural conditions; to give farm and city women a better understanding of their mutual problems and responsibilities; to further the conservation of natural resources; to encourage concern for national and world problems; to promote the education of women in agriculture, horticulture, and related professions; to offer opportunities for the marketing of handiwork and products of the farm and garden. Scholarships for girls studying horticulture, animal husbandry, and home economics.

Total Membership: 8,000 members in 11 divisions

Publications: *The National Farm and Garden Magazine*, quarterly; *The Country Woman*, monthly

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